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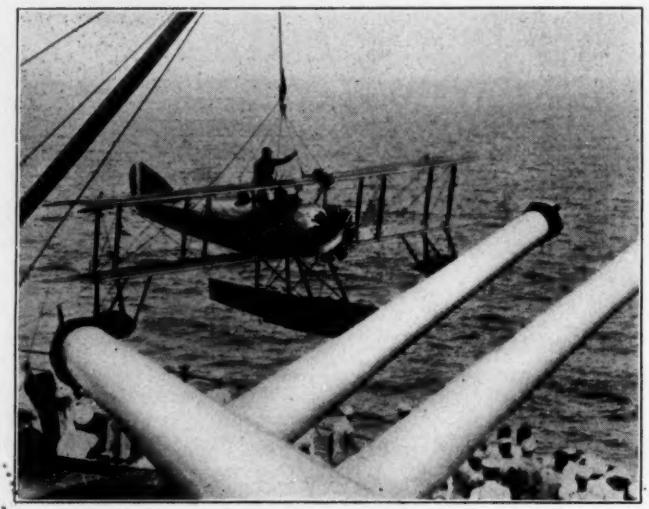

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VOL. NO. 52, NO. 7 JULY, 1926 WHOLE NO. 281

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NAVAL COMMUNICATIONS AND GOVERNMENTAL REORGANIZATION

BY LIEUTENANT COMMANDERS W. S. HOGG AND A. P. H. TAWRESEY, U. S. NAVY

1. The "Scheme of Reorganization of the Executive Departments suggested by the President and the Cabinet at the request of the Joint Committee on Reorganization," was transmitted to the Chairman, Mr. Walter F. Brown, by the President, by letter of transmittal dated February 13, 1923. The plan was accompanied by a diagram, but contained no arguments, statements, or reasons for or against the changes. Although details have been altered, the plan is still generally a live issue in administrative circles. It is the purpose of the authors of this article to set forth some of the considerations involved in the government reorganization plan, as affecting naval communications. It is not intended to draw definite conclusions, and many of the statements are merely personal opinions.

2. So far as communications are concerned, the proposals of the plan are:

First: To establish an executive office for communications under the under-secretary for national resources (new), who, in turn, is under the secretary for national defense (new).

Second: To change the name of the Post Office Department to "Department of Communications," and to establish an assistant secretary for telephony and telegraphy (including radio) as a branch thereof.

3. The assumed objects of the plan are:

a) To distinguish between civil and military communication, the former to be handled by the post office, the latter by the military.

b) To provide in its broadest sense an efficient communication service for the United States (mail, telegrams, cablegrams, telephones), domestic and foreign.

4. Before proceeding with a discussion of the merits of the plan, it is well to examine some of the fundamentals of government as regards the functions of the civil and military. With respect to foreign relations the nation may be in one of three well established conditions, viz.:

(a) At peace; (b) At war; (c) In a state of neutrality.

5. When the nation is at peace the functions of the government are civil, i.e., the government exists for the *public at peace*. The civil population is responsible that the military is furnished with men and material to fulfill their function. The military assists in maintaining this condition by preparing to protect or strike for the civil. Hence, the functions of the military during peace are essentially on behalf of the civil. This fact is not popularly realized by the civil population, nor in some cases by the military.

6. During war, the government exists for the *public at war*. The fact that war exists, indicates that the primary functions of the government are military, i.e., the government can no longer operate in the civil way. Under such conditions the civil must assist the military in every possible way. Hence, the functions of the civil during war are essentially on behalf of the *military*. Although this fact is not clearly realized by the populace, the civil cannot shirk its responsibility in this regard.

7. Between the extremes of peace and war there are various degrees of neutrality during which success is assured, only through the close cooperation of the civil and military.

8. As a matter of fact, it is evident that the utmost cooperation between the civil and military is necessary *at all times*.

9. It is the duty of both civil and military to be efficient in performing the functions required of them under any existing condition. During peace this involves for both civil and military:

a) Exercising their civil functions.

b) Planning for war functions.

During war it involves for both:

a) Exercising their war functions.

b) Planning for a peace-time basis.

During various vicissitudes of neutrality it may involve either of the above courses, or partly one and partly the other.

10. Peace is the condition which obtains most of the time. Governments are, therefore, organized primarily for peace. Other things being equal, wars are won by states which can best and earliest adapt their peace-time government to war use. If the duties of government are properly discharged during peace, the transition to war can be made easily, efficiently, and economically. Hence, the civil should always make full use of the military services, and the military must be ready to strike for the civil at any time.

11. In proceeding with the discussion of the proposal of reorganization, as applying to communications, it is convenient to examine first the situation as it exists at the present time; second, the effect of the plan on the efficiency of naval communications, and the conclusions reached from study of the preceding facts.

12. The following phases of rapid communication must be provided for, whether a communication department is established or not:

a) Communication policy,

b) Questions of rates,

c) Questions regarding the collection of charges and the settlement of accounts,

d) Rules regarding acceptance and transmission of messages and the provision that inter-communication between different companies and (or) systems is not to be refused,

e) Laws and conventions and enforcement thereof—cable and radio landing rights and privileges,

f) Publication of information of all kinds,

g) Rules to prevent radio interference and confusion,

h) Apportionment of radio waves,

i) Rules for uniform working,

j) Questions of competition,

k) Questions regarding monopolies,

l) Questions regarding copyrights,

m) Research and technical problems,

n) Rules regarding mobile stations—ships and aircraft, etc.,
o) Questions regarding safety of life and navigation,
p) Time signals and hydrographic information,
q) Questions regarding meteorology—collection and dissemination of weather forecasts and warnings,
r) Questions regarding military communications,
s) Rules regarding government messages, and
t) International code.

13. The foregoing phases have an international, a national, an inter-state, and a local aspect, as may be seen by applying these adjectives to any of them. They must be applied to all means of rapid communications, including cables, telegraphs, telephones, radio telegraphy, radio telephony, visual signalling, and sound signalling.

14. While purely local questions, which affect only an immediate locality, are ones of municipal government, the line of demarcation between purely local questions and those of greater extent is not always clearly defined, and a central agency is necessary to possess all information, even local, to assist in standardizing local conditions and to adjust conflicts of interest.

15. The present radio laws of the United States are contained in:

a) Department of Commerce pamphlet—*The Radio Laws of the United States.*
b) Joint Resolution of June 5, 1920.
c) Joint Resolution of April 14, 1922.
d) Joint Resolution of February 28, 1925.

16. At the present time communication questions are handled as follows:

17. Foreign questions affecting communications are handled by the President and State Department, with the advice they have available. To indicate the scope of questions involved in communications, and required to be handled at present by the relatively complex organization in effect, the following international propositions are now before the United States through the State Department:

a) The changes and additions which were proposed at the Washington Communication Conference in the provisions of the International Radio Telegraph Convention concluded July 5, 1912,

to which the United States is a party, in the provisions of the International Telegraph Convention concluded at St. Petersburg on July 10-22, 1875, and in the traffic regulations adopted in accordance with the terms of these conventions;

b) The report of the Technical Committee on International Radio Communication and the preparation of data relative to radio stations called for by that report;

c) The terms of a convention for fixing the status of submarine cables in war time;

d) The revision of the convention concluded March 4, 1884, for the protection of submarine cables;

e) The proposed international regulations concerning visual and sound signalling;

f) The proposals of the Washington Communications Conference in reference to cable and radio monopolies, and to making available for common use islands and other points as cable relay stations;

g) The revision, if any changes are found necessary, of existing copyright laws and agreements to make possible protection to material transmitted by radio.

18. The State Department has naturally called for assistance and advice on these large questions from government departments and from private interests which are in a position to help. A special inter-departmental committee on electrical communications has been appointed to insure the fullest cooperation in preparing for international communications conferences, one of which (radio) is to be held in Washington in the near future.

19. The United States delegates to the Pan-American Conference were advised to urge the holding of a Washington Pan-American communications conference to develop the communication needs and policies of the American countries as soon as possible, and in any event, preliminary to the International Conference. This conference was held in Mexico City in 1924, and was abortive so far as the United States was concerned because it produced a document premised on purely government ownership and operation of all means of electrical communication.

20. All radio acts, conferences and regulations are enforced by the Department of Commerce. That department has had to deal with many vexing radio questions, caused primarily by the widespread interest in radio broadcasting. Radio broadcasting, how-

ever, cannot be divorced from general radio questions, and the settlement of radio broadcasting questions has, by the very nature of radio, forced simultaneous action on other radio questions. Four national radio conferences have been held under the auspices of the Department of Commerce, and the recommendations of the latest one, if adopted by the various interests, as they probably will be, are expected to solve many radio problems.

21. The Department of Commerce has been somewhat handicapped in executing its enforcement powers. The present law does not permit the Department to revoke licenses. The settlement of the Simon case determined this point. The power of revocation of licenses is one of the best instruments of enforcement of law that can be had. The White Bill, now pending, confers this power definitely.

22. The Interstate Commerce Commission has certain powers of regulation over interstate matters. Section 1 of the Interstate Commerce Commission Act gives that commission power over interstate transmission by wire or wireless. By an opinion dated December 10, 1922, the commission considers that it has jurisdiction over wireless messages from a commercial station in the United States to a ship at sea, whether it be a United States or a foreign ship. It does not consider that it has jurisdiction over messages between American ships at sea. Tariffs and statistical reports are filed by wire companies with the commission for information. Complaints are taken up by Interstate Commerce Commission, but they have been few in number. The Interstate Commerce Commission prescribes methods of accounting to be followed by telephone companies.

23. The Post Office Department regulates government telegraphic rates, and operates a limited radio service in connection with the air mail service. The Postmaster-General, under the Act of 1866, sets (annually) the rate to be charged the United States government for its telegraph messages.

24. The War and Navy Departments operate their communication systems, which are at the service of the other government departments, and, in certain cases, directly at the service of the public.

25. Courts of law decide many questions which are covered by the law.

26. Certain other government departments are interested in radio and telegraph communication, although they do not operate stations. At present they avail themselves of commercial facilities and of the facilities offered by the government departments which do operate systems.

27. There are many outstanding questions of a purely national character, the need for settlement of which is urgent, viz.:

a) What communication services should be furnished by the government?

(1) For the government departments.

(2) For the public.

b) To what extent should government communication facilities existing, or contemplated, be used in furnishing the services required?

c) To what extent should private communication systems, existing, or contemplated, be used in furnishing the services required?

d) The necessity, if any, for additional government facilities, and the government departments which should have cognizance thereof.

e) The means to prevent unnecessary duplication of government facilities.

f) The arrangement for defrayment of expenses incurred.

28. In the absence of other regulation each specific case in dispute is settled by the Chief Coordinator. This is a hand-to-mouth procedure which may enable keeping abreast of the immediate problems which arise, but there can be no doubt that if the answers to these questions can be laid down in the form of a general policy, less confusion will result.

29. An Interdepartmental Radio Advisory Committee has been composed of a representative from each government department and other government agencies. Its function is purely cooperative and advisory. It began with the study of the problems in relation to radio broadcasting, but it was soon found necessary to increase its scope to cover government radio communication in general. Sub-committees were established, the names of which indicate their functions:

a) Material for broadcasting.

b) Operating procedure.

c) Technical problems.

d) Mobile radio.

e) Radio policy and legislation.

30. While the Interdepartmental Radio Advisory Committee has been purely cooperative and advisory, it has succeeded, without the necessity of additional legislation, in satisfactorily settling all questions so far brought before it. It has prepared and promulgated a statement of government radio policy, which all federal agencies are following. Its scope, however, is limited. It has not had to deal with questions other than radio, nor with international questions concerning radio. Its success leads to the suggestion that possibly efficiency in government communications might be attained by extending the scope of this committee to embrace all communication matters and by giving it sufficient legislative recognition to enable it to deal even with international questions.

31. Proceeding to the discussion of the effect of the establishment of the Department of Communications on the efficiency of the Naval Communication Service, it is necessary to review the general government interest in owning and operating radio stations. The government is interested in owning and operating radio stations to the extent of keeping them adequately trained for war, and for serving the merchant marine and aircraft where private stations are not maintained. To this end, the government must keep its stations constantly employed. Since it must maintain its stations, it is an economy to the government to handle its own traffic, regardless of department, through its own stations. Where government stations do not exist, the government must resort to private radio facilities in the same manner as it resorts to privately owned and operated railroads and telegraph companies. The government also owns and operates a limited number of mobile radio stations, federal police boats and automobiles, light vessels, coast guard craft, post office planes, etc. Such mobile stations should make use of existing government facilities, or of private or contract facilities, and should not erect additional government stations except where such action represents the only solution of the problem.

32. In presenting the Navy's side of the case, the discussion will be narrowed to rapid communications, which term is used to distinguish definitely communications by message, telephone, telegraph, radio, etc., as distinguished from communications by mail. The Navy's mail is handled in the same manner as civil mail (ex-

cept for war censorship). Since the element of secrecy is easily obtained by mechanical means, there is no necessity for the Navy to handle its mail in any other way. This does not apply, however, to the case of communications by the rapid means, because of the basic difference in the means of transmission of mail and that of messages by rapid means. This difference exists in fact, and is not a mere theory.

33. Further, in examining this question, it is necessary to distinguish carefully between separate activities and those which are adjuncts—for instance, the Army and Navy are separate activities, although with proper coordination, one may act as an adjunct to the other in any given particular operation. On the other hand, the fleet aircraft are actually an adjunct to the fleet—one and inseparable for training and for war; likewise, the Naval Communication Service is an adjunct of the fleet and of the Navy, indispensable for training during peace and for operation during war.

34. There is a well defined field which the Navy must occupy for its own administration and for fleet operation. This principle was recognized at the time the Roosevelt Board of 1904 made its report on the service of wireless telegraphy in the national government.

35. The Navy's essential needs ashore during peace or war are the full control and operation of:

a) A chain of high power stations to insure communication with the vessels of our fleets in any waters in which they may operate, and for communication with our outlying possessions;

b) A system of medium power stations for direct communication between ship and shore, and to link up the fleet with (*a*);

c) A system of low power stations for communication with small vessels, and for direct communication between ships and naval stations;

d) A system of radio compass stations for tracking of enemy vessels; and

e) At navy yards and stations:

(1) Communication offices,
(2) Telephone exchanges,
(3) Telegraph offices,
(4) Landwires,
(5) Post offices, and
(6) Pigeon stations.

These facilities are vital during war and, for purposes of training and development, are essential in time of peace. They are equally as essential as any other part of the Navy. They are an adjunct to our naval forces and must maintain that high degree of training necessary to form a successful adjunct to our naval forces. To have less is negligent; to have more unnecessarily increases naval appropriations and holds men and material ashore that should be at sea. Any other essential government station ashore should be paid for by the department concerned. Of course, Army and Navy facilities should handle other government department messages within the limit of their capabilities, but army and navy facilities should not be *increased* for this purpose.

36. The mission of the Naval Communication Service is to serve the best interests of the public, by furnishing efficient communication for our fleets. The Naval Communication Service, including the above outlined shore establishments, is essential to the success of this mission. It is likewise essential that the military facilities, where they exist, be used to the best interests of the public, at all times.

37. The navy radio system is an integral part of the Navy, and its maintenance and operation in peace is of equal importance to the maintenance and operation of the surface, sub-surface and air vessels of the Navy. The radio service of the Navy must, if it is to fulfill its proper mission, be operated in time of peace under the same management and direction as it will be operated under in time of war. That this management must be the Navy Department, there can scarcely be any question. If the Navy could depend implicitly on commercial radio stations, so that in time of war they might be taken over and operated immediately at a high degree of efficiency in accordance with naval standards, it might be satisfactory to have commercial companies operate most, if not all, of the shore radio stations in time of peace. Such a situation is not practicable, however, and both study and experience have shown that commercial stations cannot be taken over and operated satisfactorily at war time efficiency without long delay, particularly in connection with training personnel to bring them to the Navy standard. Similarly, if stations were operated by another department of the government, the reduced efficiency, due to sudden administrative changes in operating organization, which would occur at the outbreak of hostilities, is too well known to need comment.

The suddenness with which such outbreaks occur, if not adequately provided against, may mean the difference between failure and success in our plans for national defense. Civilian personnel in commercial or non-military government stations cannot be trained in naval methods, procedure, and discipline so as to insure the degree of efficiency necessary at the outbreak of hostilities. Such personnel is, moreover, more apt to be biased in their political opinion and more greatly affected in their sympathies abroad than is military personnel, although they may have marked operating ability judged from a commercial standard. A small percentage of such civilian personnel may be expected to be disloyal.

38. At the present time it is not possible to make a chain of commercial stations in important strategical positions, or for coastwise purposes in any sense adequate for the Navy. The Navy, being the first line of defense, will, in any emergency, probably be the first of the armed forces of the United States to make contact with the enemy's forces. Its communication service must, therefore, be continuously ready for any such national emergency. If the maintenance, control, and operation of the navy radio system, as well as of the fleets, are not completely under the jurisdiction of the Navy, it will not be effectively prepared to perform the duty allotted to the Navy in the national defense.

39. The general government policy of radio communications should set forth that the Navy's needs along the coast for high power oversea communications are predominant. The radio communication in the interior of the country is naturally no concern of the Navy, except insofar as it involves interference with high power oversea communication with fleets and vessels off the coast.

40. The measures to be taken for the defense of any country are not necessarily parallel to those essential in other countries. For example: the German general staff decided that government-owned and operated railroads were a military necessity for the German Empire, and the wisdom of their decision was well borne out by the events of the Great War. Conditions in the United States, particularly as regards geographical considerations, are such that the arguments advanced by the German general staff for government ownership and operation of railroads in no sense apply. As set forth in preceding paragraphs, however, government ownership and operation, and, in fact, specific operation by the Navy Department, of an adequate system of radio communi-

cation are essential for the operation of our fleet and hence for our scheme of national defense. The situation of the United States in this respect is somewhat similar to that of Great Britain. Prior to the war the British Government did not have any naval shore radio service, although the shore radio service of Great Britain was under the General Post Office and was government operated. The experience of the British Navy, which took over all the shore radio stations on the outbreak of the war, was such that, at the conclusion of the war, the Navy retained ownership and operation of nine of the shore radio stations. Considering the area and coast line of the British Isles, this is relatively a much greater number of stations than is now maintained by the United States Navy.

41. It is fundamental that the number of government departments operating radio stations should be kept as few in number as possible for the general good of the country, thus avoiding duplication of effort and expense and conserving public funds. As previously explained, it is essential that the Navy predominate along the coast, and it is therefore apparent that government radio facilities along the coast should be provided as far as possible by the Navy. Similarly, military considerations in the interior of the country require a radio system operated by the Army, and it seems logical therefore that all government radio facilities in the interior of the country should be provided as far as possible by the Army. Since the War Department and the Navy Department continually work together in the interests of national defense, it seems probable that if they operated all government radio stations, closer liaison and consequently better control would be realized, but this idea is subject to the limitation mentioned in the last sentence of paragraph 35, above.

42. In view of the recent development of radio, the increased ranges available, and the decrease of interference because of superior apparatus, and in view of the fact that the government does not desire and it is not allowed to compete with commercial or private interests, wherever the latter set up stations, it is certain that a number of the government's low power stations may be abandoned in the near future.

43. It is felt that the Post Office Department and other government departments are not necessarily as dependent on operating radio activities as are the War and Navy Departments. Mail is

carried on trains, but that fact does not operate as an argument that the Post Office Department should control and operate the railroads. For the moment, the Post Office Department is interested in radio solely on account of the air mail service. It is probable in a few years the air mail service will pass into the hands of private owners, like the railroads, as the only reason for the existing government ownership of airways is to help commercial aviation get a start. When this occurs, the Post Office Department will have little or no interest in radio.

44. All matters bearing on the advancement of science, applied to radio communication, and all benefits that may be derived from the development of the art, are of fundamental importance to the Army and Navy, but are not of such elementary and fundamental importance to any civilian department which exists or which may be created. Armies and navies of the future cannot hope for success without radio equipment developed to the highest degree that the scientific knowledge of the day permits. On the other hand, activities of civilian departments of the government will be by no means so vitally concerned in radio.

45. Proceeding to the conclusions to be reached from this study, the establishment of a communication department to perform a communication service for the United States, does seem to be logical and ideal. It has proved eminently successful in the handling of mail, and might be equally successful in the handling of rapid communications. In view, however, of the complexity of the problem, perhaps the best present solution would be to give more power to the Interdepartmental Radio Advisory Committee.

46. Should it be found that the functions of the Interdepartmental Radio Advisory Committee cannot be extended to satisfactorily care for the communication needs of the government, it is believed that the next best solution is the designation of a department, possibly the Post Office Department, to coordinate the many administrative functions of communication. Notwithstanding this coordination of administrative functions into a department of communications, it is certain that many questions will have to be referred for advice and sometimes for execution to other departments of the government. For instance, the State Department would necessarily act as an intermediary between the Department of Communications and foreign countries on state questions of broad policy and agreement. The Department of

Communications would, of course, correspond directly with foreign administrations regarding the routine of communication business. Private communication companies have a large interest in communication questions, and their advice must not be neglected. Similarly, local and municipal governments must be called upon for assistance.

47. There is a well defined opposition among commercial interests to the establishment of a department of communications. This grows apparently out of the desire to be free from any further detailed government regulation and supervision, and would perhaps be worthy of consideration were the questions involved not so intimately connected with the public welfare. There is, moreover, particular opposition among commercial interests to the establishment of communications under the Post Office Department. This arises presumably from the fact that the Post Office Department has had a very limited experience with communication by the rapid means, whereas other departments of the Government have had extensive experience therewith and are now actively concerned with such communication on a nation wide scale. This leads to the suggestion that instead of changing the name of the Post Office Department to the Department of Communications, and giving it cognizance of all means of communication, a bureau of communications be established in the Department of Commerce, to be charged with cognizance of communications by all the rapid means. Such a bureau would absorb the present extensive communication activities of the Department of Commerce, and would in addition, undertake all the activities (except mail) proposed for the Department of Communications in this study. Additional considerations indicating the advisability of this solution are that the Department of Commerce is the present channel of contact between the Government and the International Bureau at Berne (1912 Radiotelegraph Convention), and that it is also the sponsor of the Interdepartmental Radio Advisory Committee which has accomplished so much, and the field of usefulness of which is apparently still so great.

48. The recommendation for the establishment of the Department (or Bureau) of Communications, assumed that such department would have administrative functions only. Operating functions should not be undertaken unless they are not provided by existing commercial agencies or the military departments. The

military departments must operate stations in peace and war, and it is therefore most logical that they be required to furnish the maximum possible service of the government. Any additional facilities contemplated over and above the existing military facilities, should be contracted for with commercial firms in the same manner, for instance, as the Post Office Department contracts with the railroads for the transportation of mail.

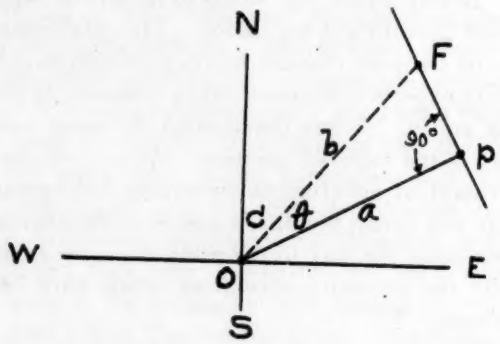
49. In connection with the foregoing considerations, the attitude of the United States with regard to public utilities must be considered. Briefly stated, this seems to be private ownership and operation with government regulation. The establishment within recent years of the very efficient parcel post system, which nearly put the private express companies out of business, is directly contrary to this policy. A live question of the same nature at the present time, is the railroad question. At present there appears to be no prospect of government ownership and operation of the railroads. In any event, the final solution of the railroad question will doubtless point the way to the solution of the communication question, with the necessary exceptions which must be made for national defense.

SIMPLIFIED NAVIGATIONAL METHOD

For computing Fix from Saint-Hilaire Position-lines

By Commander H. S. Babbitt, U. S. Navy

I. *To compute fix from brought-up line.*



Given: $\overline{O}$ = assumed position (nav. position, in this case)

OP = altitude difference $= a$

$\angle NOP$ = direction of a, $\begin{cases} \text{if } a \text{ is toward, its direction} = \text{azimuth} = z, \\ \text{if } a \text{ is } away, \text{ its direction} = 180^\circ + z = z + \pi. \end{cases}$

PF = present line

OF = brought-up line.

Required: Compute fix F.

Solution: Let $\overline{OF} = b$,

$\angle POF = (\angle NOP \sim \angle NOF)$, $= \theta$ (which is an acute $\angle$ of a rt. $\triangle$)

and $\angle NOF$ (direction of b such that θ *is* acute) $= C$.

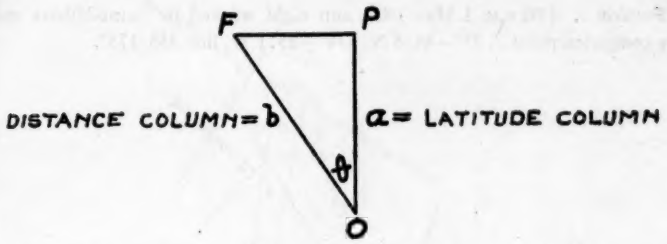
Then

(1) From traverse tables, in right triangle OPF, under angle θ as *course*, for a in *latitude column*, find corresponding b in *distance column*:

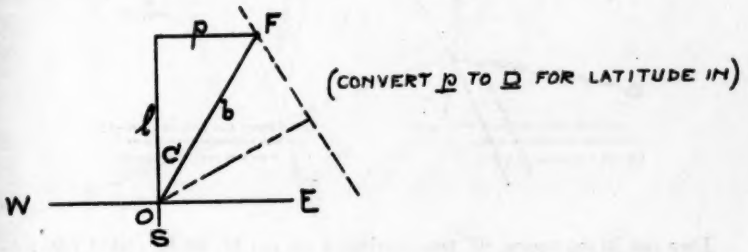
Editor's Note:

In presenting this article the author writes as follows:

"This method is extremely simple in practice. But it is found difficult to present it clearly in writing; and particularly, clearly to convey the idea that no plotting or charting is necessary or contemplated. It would appear that it can be best presented by the "case-method"; and that a certain number of examples, sufficient to indicate different applications, are therefore necessary. The diagrams are intentionally simply diagrammatic,—only approximate sketches to indicate the nature of the different applications."



(2) With traverse tables *as* traverse tables, find diff. latitude l and diff. longitude D for the distance b on course C:



(3) Apply the l and D thus found to the latitude and longitude respectively of assumed position O, and resultant will be the sought latitude and longitude of point F.

Procedure in practice: In actual practice, neither diagrams, charts, nor plotting are in any way essential:

(1) Set down direction of a, if $\begin{cases} a \text{ is toward, } = z, \\ a \text{ is } away, = z+\pi \end{cases}$

(2) Set down that direction of b (brought-up line), *which is nearest* (1),—and mark such direction $= C$.

(3) Take $\angle\theta$ = difference between (1) and (2). (Note that θ is to be $<90°$,—which *checks* whether C has been taken properly).

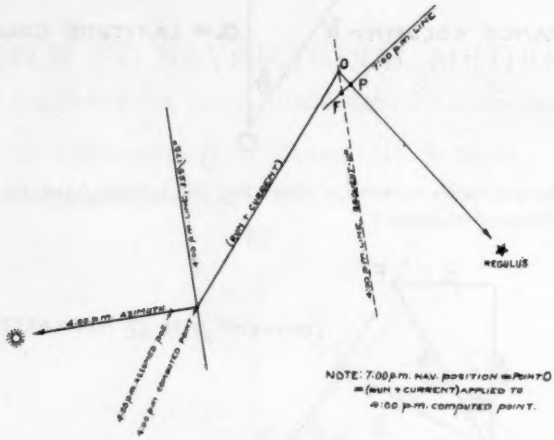
(4) Under course angle θ, for a in latitude column, take b in corresponding distance column.

(5) Find l and D for the distance b on course C.

(6) Apply l and D thus found to the L and λ respectively of the assumed (nav.) position, and result will be the L and λ of fix.

Form for solution: A suggested form for the practical solution, and different applications of the method, are indicated in the examples which follow. (In these examples, diagrams have been included in the *statements* of the problems, to assist in the presentation of same and to better show the particular application of the method in each. It is to be understood however,—and should be particularly noted—that *such diagrams are not utilized in*, and *are entirely unnecessary and extraneous to*, the actual *solutions*).

Problem 1. 4:00 P.M. 1 May 1922, sun sight worked by Saint-Hilaire method gave computed point *L* 35°−44′.8 N, λ74°−25′.1 W, line 355/175°.



Then ran 30 mi. course 30° true, current ½ mi. per hr. set 85°, until 7:00 P.M. when sight of star Regulus worked for navigator's position L 36°−10′.9 N, λ74°−04′.8 W, gave a=1.4 mi. toward, z=163°.

Required: Compute 7 P.M. fix F given by the brought-up 4 P.M. line.

Solution: 7 P.M. (Reg.), a=1.4 mi. toward, z=163°.
4 P.M. sun line ran.....175° =C

θ= 12°, ∴b=1.43 mi.

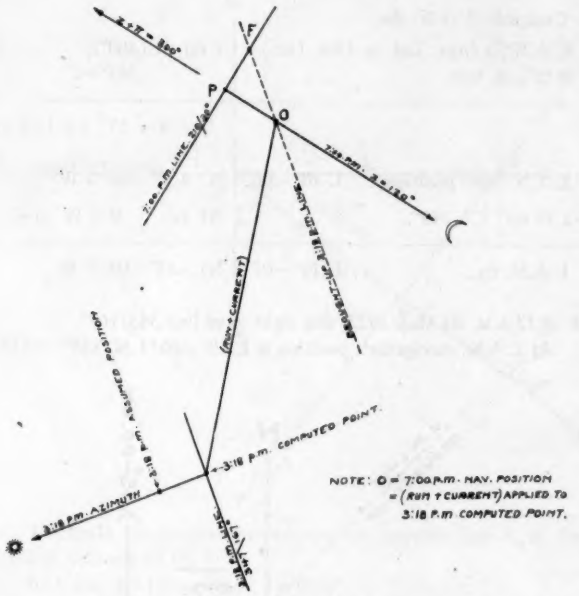
7 P.M. nav. pos., L 36°−10′.9 N, λ74°−04′.8 W.

b=1.43, C=175°, 1 1.4 S, D 0 .2 E. (p=.125)

7 P.M. fix,.....L 36°−09′.5 N, λ74°−04′.6 W.

Problem 2. 3:18 P.M. 28 April 1923, sun sight worked by Saint-Hilaire method gave computed point L 36°−26′.1 N, λ74°−30′.5 W, line 347/167°.

Then ran 37 mi. course 10° true (current one mile per hour set 77° true) until 7:00 P.M., when moon sight worked by Saint-Hilaire method for nav. position L 37°−03′.3 N, λ74°−18′.0 W, gave a=2.25 mi. *away*, z=120°, $z+\pi$=300°.



Required: Compute the 7:00 P.M. fix F given by the brought-up 3:18 P.M. line.

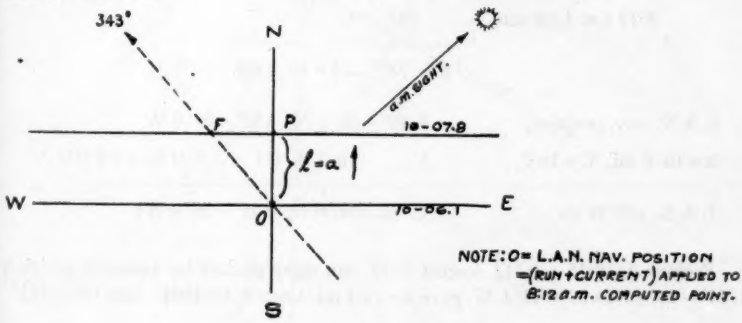
Solution: 7:00 P.M., $a=2.25$ mi. *away*, $z+\pi=300°$,
3:18 P.M. line ran,..... 347°, =C.

$\theta=47°$, $\therefore b=3.3$ mi.

7:00 P.M. nav. pos., L 37°−03′.3 N, λ74°−18′.0 W.
$b=3.3$ mi., C=347°,.....1 3. 2 N, D 0 .9 W (p=.74W)

7:00 P.M. fix,.....L 37°−06′.5 N, λ74°−18′.9 W

Problem 3. 8:12 A.M. 20 May 1923, sun sight gave line 343/163°. L.A.N. meridian altitude of sun, for navigator's position L 10°−06′.1 N, λ35°−05′.0 W, gave Lat. by Obs. 10°−07′.8 N.



Required: Compute L.A.N. fix.

Solution: L.A.N., a (nav. Lat. to Obs. Lat.) = 1.7 mi. N (360°),
8:12 A.M. line,..... 343° = C

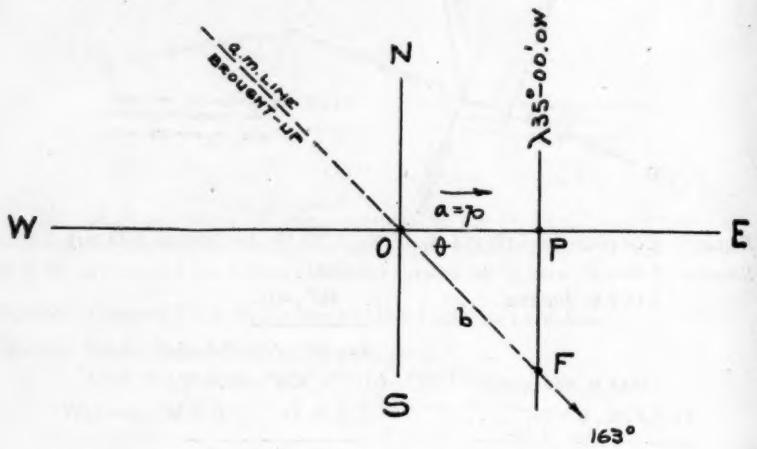
θ = 17°, b = 1.78 mi.

L.A.N. nav. position,...L 10°−06′.1 N, λ35°−05′.0 W

b = 1.78 mi., C = 343°,.....(l 1.7 N) D 0.5 W (p = .52)

L.A.N. fix,.....(L 10°−07′.8 N), λ35°−05′.5 W

Problem 4. 8:12 A.M. 20 May 1923, sun sight gave line 343/163°.
At L.A.N. navigator's position is L 10°−06′.1 N, λ35°−05′.0 W.



Required: Compute L.A.N. fix corresponding to λ35°−00′.0 W, as given by the brought-up 8:12 A.M. line.

Solution: L.A.N. { D = (nav. λ to Obs. λ) = 5′.0 E
p = a = 4.92 mi. E. (90°) }
8:12 A.M. Line ran,.....163°, = C

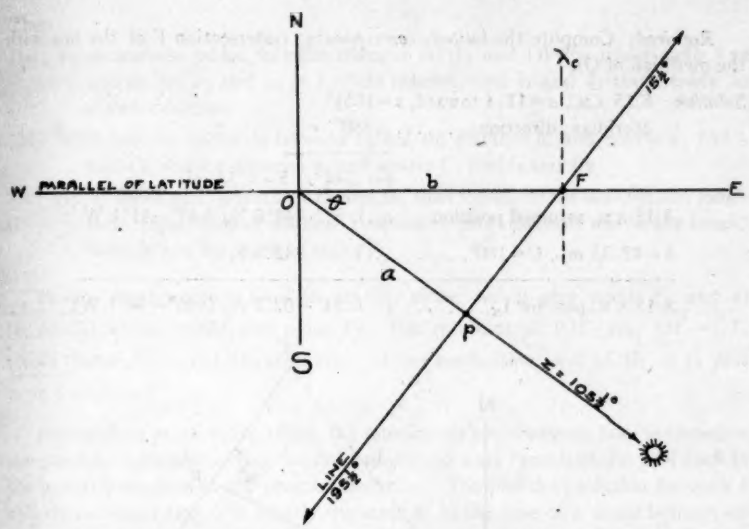
θ = 73°, ∴ b = 16.8 mi.

L.A.N. nav. position,.....L 10°−06′.1 N, λ35°−05′.0 W

b = 16.8 mi., C = 163°,.....l 16.1 S, (D 5.0 E, p = 4.91)

L.A.N. λ35°W fix,.....L 9°−50′.0 N, (λ35°−00′.0 W)

Problem 5. 8:15 A.M. 12 August 1922, sun sight worked for assumed position L 51°−44′.6 N, λ46°−44′.1 W, gave a = 11.3 mi. toward, z = 105½°, line 195½/15½°.



Required: Compute the *longitude corresponding* (intersection F, of the line with the parallel of latitude of 0).

Solution: 8:15 A.M. $a = 11.3$ toward, $z = 105\frac{1}{2}°$.

Parallel of latitude, direction... 90°, $= C$

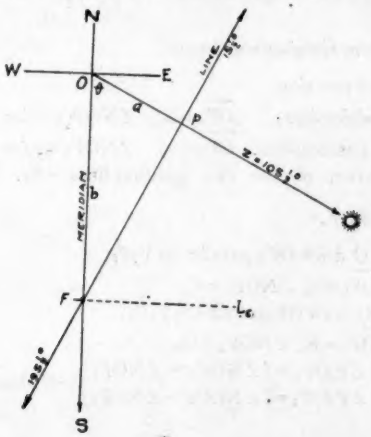
$\theta = 15\frac{1}{2}$, $b = 11.73$ mi.

8:15 A.M. assumed position.....L 51°−44′.6 N, λ46°−44′.1 W

$b = 11.73$ mi., C=90°,.....D 18.9 E (p=11.73)

8:15 A.M. pos. for λ_c .....(L 51°−44′.6 N), λ46°−25′.2 W

Problem 6. 8:15 A.M. 12 August 1922, sun sight worked for assumed position L 51°−44′.6 N, λ46°−44′.1 W, gave $a = 11.3$ mi. toward, $z = 105\frac{1}{2}°$, line $195\frac{1}{2}/15\frac{1}{2}°$.



Required: Compute the *latitude corresponding* (intersection F of the line with the meridian of O).

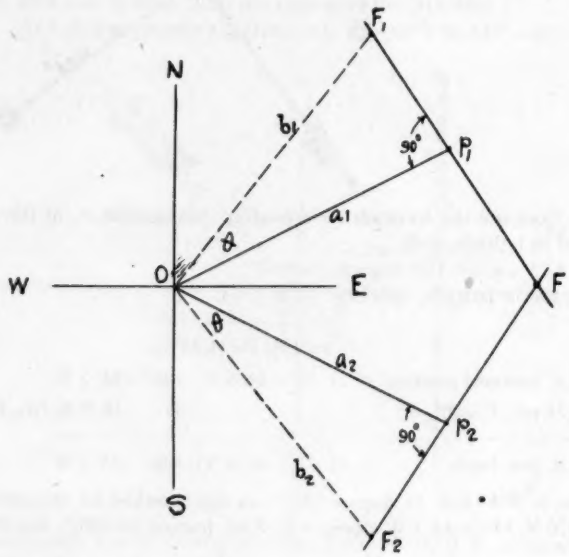
Solution: 8:15 A.M., $a = 11.3$ toward, $z = 105\frac{1}{2}°$
Meridian, direction.....180°, $= C$

$\theta = 74\frac{1}{2}°$. $b = 4.33$ mi.

8:15 A.M. assumed position,.....L 51°−44′.6 N, λ46°−44′.1 W

$b = 42.33$ mi., C = 180°,.....l 42.3 S.

8:15 A.M. pos. for L_c,.....L 51°−02′.3 N, (λ46°−44′.1 W)



II. *To compute fix from simultaneous lines.*

Given: O = assumed position.
F_1P_1 = first position-line. $\overline{OP_1} = a_1$. $\angle NOP_1 = z_1$ (or $z_1 + \pi$)
F_2P_2 = second position-line. $\overline{OP_2} = a_2$. $\angle NOP_2 = z_2$ (or $z_2 + \pi$)
F = intersection of the two position-lines, = fix.

Required: Compute fix F.

Solution: Through O draw OF_1 parallel to F_2P_2;
Let $\overline{OF_1} = b_1$, $\angle NOF_1 = C_1$
Through O draw OF_2 parallel to F_1P_1;
Let $\overline{OF_2} = b_2$, $\angle NOF_2 = C_2$.
Also, let $\left\{\begin{matrix} \angle P_1OF_1 = (\angle NOP_1 \sim \angle NOF_1 \\ \angle P_2OF_2 = (\angle NOP_2 \sim \angle NOF_2 \end{matrix}\right\} = \theta$ (which is an acute ∠)

Then

(1st) From traverse tables, in right triangles OP_1F_1 and OP_2F_2, under angle θ as course, for a_1 and a_2 in *latitude* column, find b_1 and b_2 respectively in *distance* column.

(2d) With traverse tables *as* traverse tables, for distance b_1 and course C_1 find l_1 and D_1, and for distance b_2 and course C_2 find l_2 and D_2.

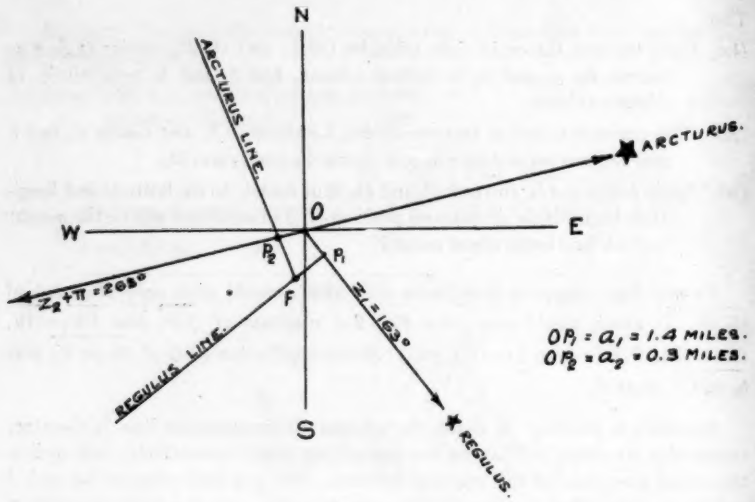
(3d) Apply *both* l_1 and l_2, and *both* D_1 and D_2, thus found, to the latitude and longitude respectively of assumed position O, and resultant will be the sought latitude and longitude of point F.

Proof: Application to O of ($\overline{b_1 \text{ on } C_1}$), alone, would give point F_1, and of ($\overline{b_2 \text{ on } C_2}$), alone, would give point F_2. But resultant of ($\overline{OF_1}$ *plus* $\overline{OF_2}=\overline{OF}$. (Note that $\overline{F_1F}$ is=and $\|$ to $\overline{OF_2}$, etc.) Hence application to O of ($\overline{b_1 \text{ on } C_1}$ *plus* $\overline{b_2 \text{ on } C_2}$) gives F.

Procedure in practice: In effect, the solution for simultaneous lines is therefore comparable to simply solving for *two* brought-up lines cumulatively; and such is the actual procedure in the practical solution. The practical solution for each b and its corresponding C is exactly the same as in the case of a single brought-up line; and likewise as with a single line, neither are any diagrams, chart, nor plotting at all needed. Suggested form, and different applications of the method, for the simultaneous solution, are indicated in the examples which follow. (Note that the diagrams which are given in the *statements* of the different problems, are not utilized in, and are entirely unnecessary and extraneous to, the actual *solutions*: These diagrams, on the contrary, are solely to assist in the statement of the problem, and to show the particular application of the method in each).

Problem 7. 7:00 P.M. 1 May 1922 simultaneous star sights of Regulus and Arcturus, worked for assumed position L 36°−10′.9 N, λ74°−04′.8 W, gave following:

Regulus, $a_1=1.4$ toward, $z_1=163°$, line 253/73°.
Arcturus, $a_2=0.3$ *away*, $z_2=85°$, $z_2+\pi=265°$, line 355/175°.



Required: Compute intersection fix F of these two simultaneous position-lines.

Solution: a_1 (Reg.) = 1.4 mi. toward, $z_1 = 163°$.

Arcturus line runs.....175°, $= C_1$

$\angle\theta = 12°$. $\therefore b_1 = 1.43$ mi.

a_2 (Arct.) = 0.3 mi. *away*, $z_2 + \pi = 265°$.

Regulus line runs.....253°, $= C_2$

$\angle\theta = 12°$. $\therefore b_2 = 0.31$ mi.

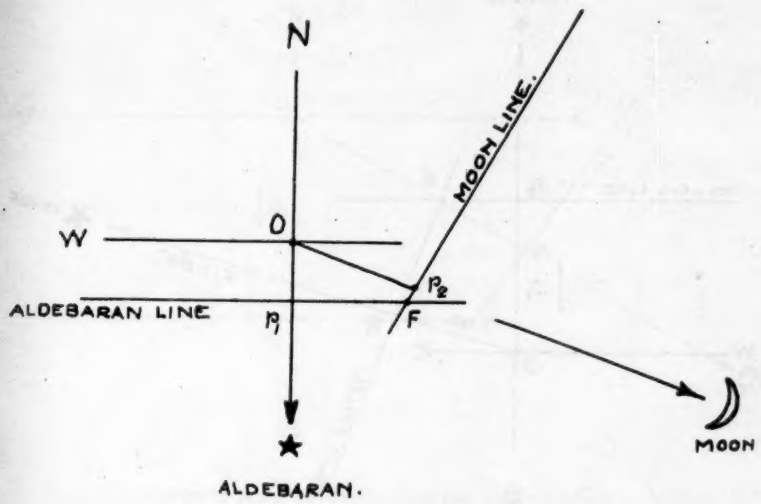
7:00 P.M. assumed position,....L 36°−10′.9 N, λ74°−04′.8 W.

$b_1 = 1.43$ mi., $C_1 = 175°$,.....l_1	1.4 S,	D_1	0.2 E ($p_1 = .125$ E)
$b_2 = 0.31$ mi., $C_2 = 253°$,.....l_2	0.1 S,	D_2	0.4 W ($p_2 = .30$ W)

7:00 P.M. fix, Reg. & Arct.,....L 36°−09′.4 N, λ74°−05′.0 W

Problem 8. 6:30 P.M. 28 Feb. 1923, simultaneous sights of star Aldebaran and the Moon, worked for assumed position L 36°−31′.7 N. λ175°−58′.0 E gave the following:

Aldebaran, $a_1 = 0.4$ mi. toward, $z_1 = 180°$, line 270/90°.
Moon.....$a_2 = 1.9$ mi. toward, $z_2 = 100°$, line 190/10°.



Required: Compute fix F.

Solution: Aldebaran, $a_1 = 0.4$ mi. toward, $z_1 = 180°$

Moon line..... 190°, $= C_1$

$\theta =$ 10°, $b_1 = .406$ mi.

Moon, $a_2 = 1.9$ mi. toward, $z_2 = 100°$

Aldebaran, line..... 90° $= C_2$

$\theta =$ 10°, $b_2 = 1.93$ mi.

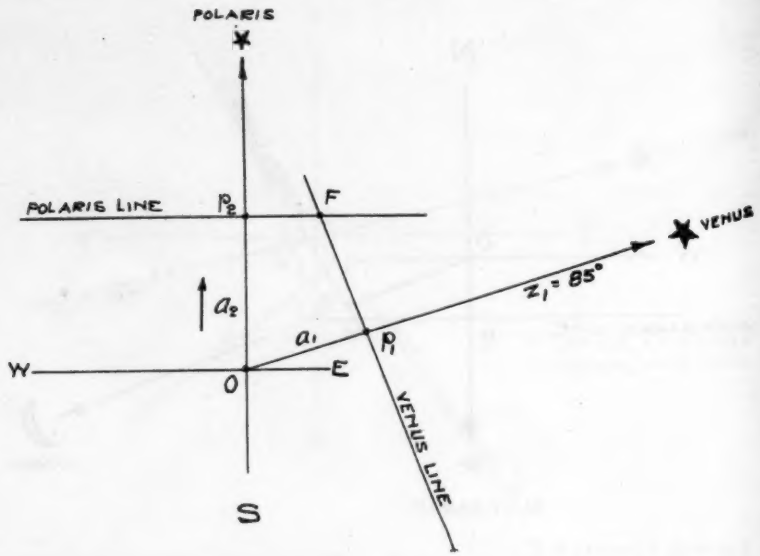
6:30 P.M. assumed position.....L 36°−31′.7 N, λ175°−58′.0 E

$b_1 = .406$ mi., $C_1 = 190°$.....l_1 0.4 S, D_1 0.1 W ($p_1 = .07$)
$b_2 = 1.93$ mi., $C_2 = 90°$..... D_2 2.4 E ($p_2 = 1.93$)

6:30 P.M. fix.....L 36°−31′.3 N, λ176°−00′.3 E

Problem 9. 5:30 A.M. 20 May 1923, simultaneous sights of Venus and Polaris, worked for assumed position L 10°−35′.0 N, λ36°−08′.5 W, gave following:

Venus, $a_1 = 2.3$ toward, $z_1 = 85°$, line 355/175°
Polaris, $a_2 = 2.9$ N.



Required: 5:30 A.M. intersection fix.

Solution: a_1 (Venus) = 2.3 toward, $z_1 = 85°$.

Polaris line ..... 90° = C_9

$\angle\theta = 5°$, $b_1 = 2.31$ mi.

a_2 (Polaris) = 2.9 toward, $z_2 = 0°$

Venus line ..... 355° = C_2

$\angle\theta = 5°$, $b_2 = 2.91$ mi.

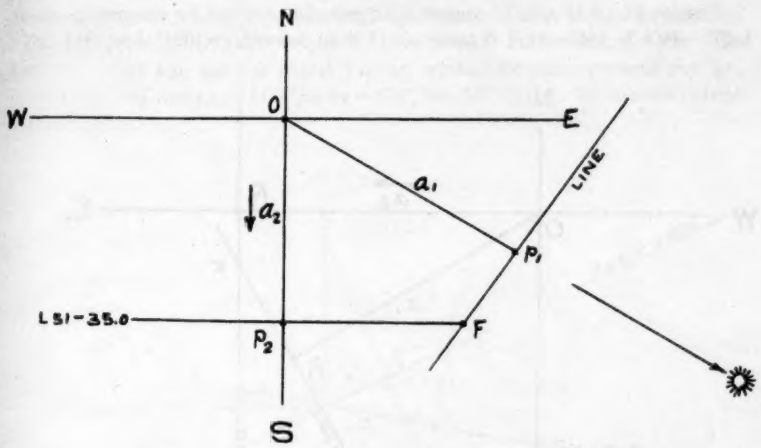
5:30 A.M. ass. pos. ..... L 10°−35′.0 N, λ36°−08′.5 W

$b_1 = 2.31$ mi., $C_1 = 90°$, . l_1 ..... D_1 2.3 E ($p_1 = 2.31$)

$b_2 = 2.91$ mi., $C_2 = 355°$ . . l_2 2.9 N, D_2 0.3 W ($p_2 = 0.25$)

5:30 A.M. fix ..... L 10°−37′.9 N, λ36°−06′.5 W

Problem 10. 8:15 A.M. 12 August 1922, sun sight worked for assumed position L 51°−44′.6 N, λ46°−44′.1 W, gave $a = 11.3$ mi. toward, $z = 105\frac{1}{2}°$, line $195\frac{1}{2}/15\frac{1}{2}°$.



Required: Compute point on the position-line corresponding to latitude 51° −35′.0 N (i.e., intersection of the line with the parallel of lat. 51°−35′.0 N).

Solution: a_2=(ass. L to obs. L)....9.6 mi. 180°.

Sun line.....195½°=C_2

θ= 15½°, b_2=9.975 mi.

Sun sight, a_1=11.3 mi. toward, z_1=105½°

The latitude parallel runs..... 90°=C_1

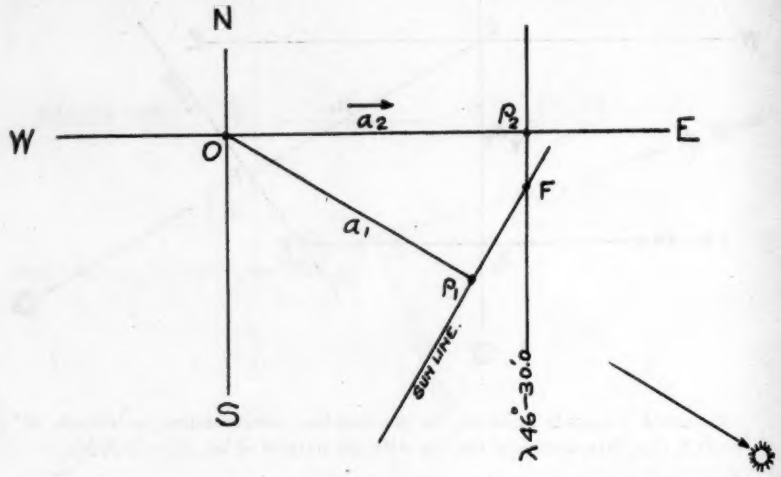
θ= 15½°, b_1=11.73 mi.

Assumed position.....L 51°−44′.6 N, λ46°−44′.1 W.

b_1=11.73 mi., C_1= 90°.l_1		D_1	18.9 E (p_1=11.73)
b_2=9.975 mi., C_2=195½°l_2	9.6 S,	D_2	4.3 W (p_2= 2.66)

L 51−35.0 N fix.....(L 51°−35′.0 N), λ46°−29′.5 W

Problem 11. 8:15 A.M. 12 August 1922, sun sight worked for assumed position L 51°−44′.6 N, λ46°−44′.1 W, gave $a=11.3$ mi. toward, $z=105\frac{1}{2}°$, line 195½/15½°.



Required: Compute point on the position-line corresponding to longitude 46°−30′.0 W.

Solution: (Assumed λ to Obs. λ) = 14′.1 E; whence p_2 (= a_2) = 8.73 mi. E

a_2 (ass. λ to obs. λ) = 8.73 mi. 90° (D_2 = 14′.1 E)

Sun line..... 15½° = C_2

$\theta = 74\frac{1}{2}°$, $b_2 = 32.71$ mi.

Sun sight, $a_1 = 11.3$ toward, $z_1 = 105\frac{1}{2}°$

The long. meridian runs..... 180° = C_1

$\theta = 74\frac{1}{2}°$, $b_1 = 42.32$ mi.

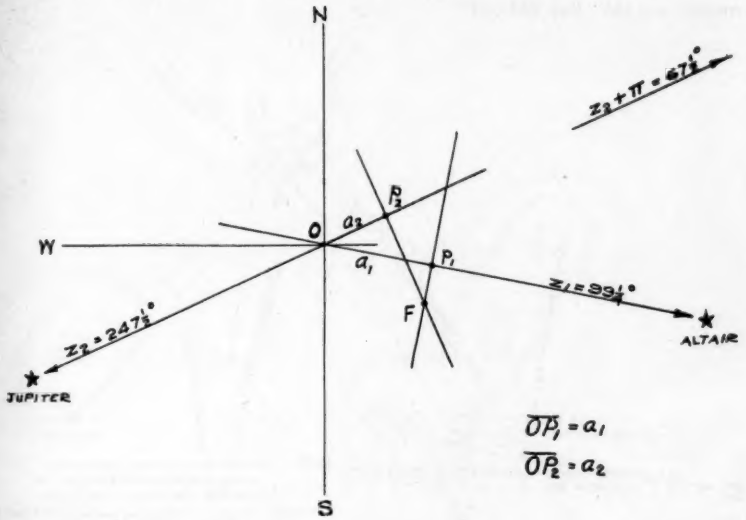
Assumed position..... L 51°−44′.6 N, λ46°−44′.1 W.

$b_1 = 42.3$ mi., $C_1 = 180°$..l_1 42.3 S

$b_2 = 32.7$ mi., $C_2 = 15\frac{1}{2}°$..l_2 31.5 N, D_2 14.1 E ($p_2 = 8.74$)

λ46°−30′.0 W fix..... L 51°−33′.8 N, (λ46°−30′.0 W).

Problem 12. 7:07 P.M. 12 August 1922 sight of star Altair, worked for assumed position L 25°−25′.0 N, λ47°−00′.0 W, gave a_1=4.2 mi. toward, z_1=99¼°, line 189¼/9¼°. 7:17 P.M. sight of planet Jupiter, worked for same assumed position, gave a_2=2.2 mi. *away*, z_2=247½°, $z_2+\pi$=67½°, line 337\157½°. No run nor current between sights.



Required: Compute intersection fix 'F' of these two lines.

Solution: a_1 (Altair=4.2 mi. toward, z_1= 99¼°.

Jupiter line runs..... 157½°=C_1

$\angle\theta$= 58¼°, b_1=8.0 mi.

a_2 (Jupiter)=2.2 mi. *away*, $z_2+\pi$=67½°

Altair line runs..... 9¼°=C_2

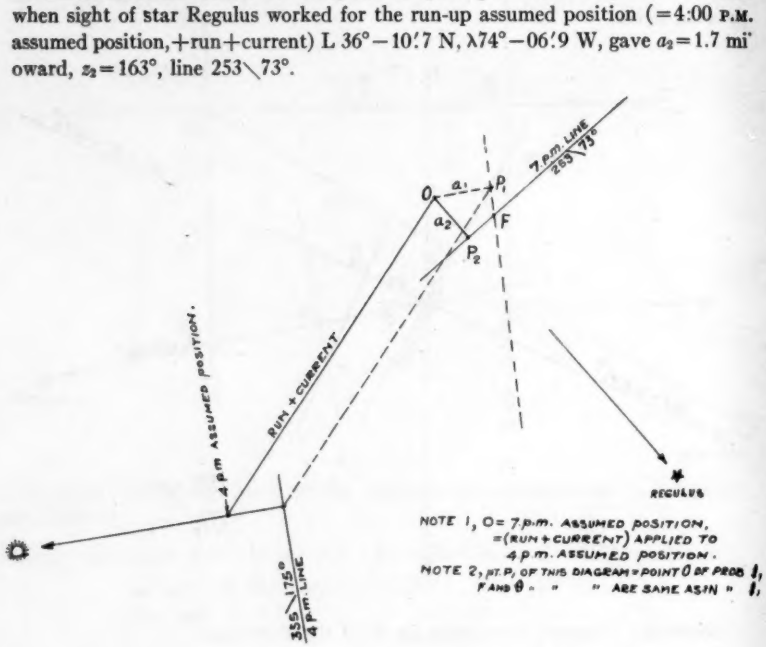
$\angle\theta$=58¼°, b_2=4.2 mi.

Assumed position.....L 25°−25′.0 N, λ47°−00′.0 W

b_1=8.0 mi. C_1=157½°....l_1	7.4 S,	D_1	3.4 E	(p_1=3.1)
b_2=4.2 mi. C_2= 9¼°....l_2	4.1 N,	D_2	0.8 E	(p_2=0.7)
Fix.....L 25°−21′.7 N,	λ46°−55′.8 W			

Problem 13. (*Compare problem 1.*) 4:00 P.M. 1 May 1922, sun sight worked for assumed position L 35°−44′.6 N, λ74°−27′.2 W, gave a_1=1.7 mi. *away*, z_1=265°, $z_1+\pi$=85°, line 355\175°.

Then ran 30 mi. course 30° true, current ½ mi. per hr. set 85°, until 7:00 P.M. when sight of star Regulus worked for the run-up assumed position (=4:00 P.M. assumed position,+run+current) L 36°−10′.7 N, λ74°−06′.9 W, gave a_2=1.7 mi toward, z_2=163°, line 253\73°.



Required: Compute 7:00 P.M. intersection fix F of the two lines.

Solution: 7:00 P.M. (Regulus), a_2=1.7 mi. toward, z_2=163°

4:00 P.M. line,..... 175°, =C_2

θ= 12°, b_2=1.74

4:00 P.M. (sun), a_1=1.7 mi. *away*, $z_1+\pi$=85°

7:00 P.M. line,.....73°, =C_1

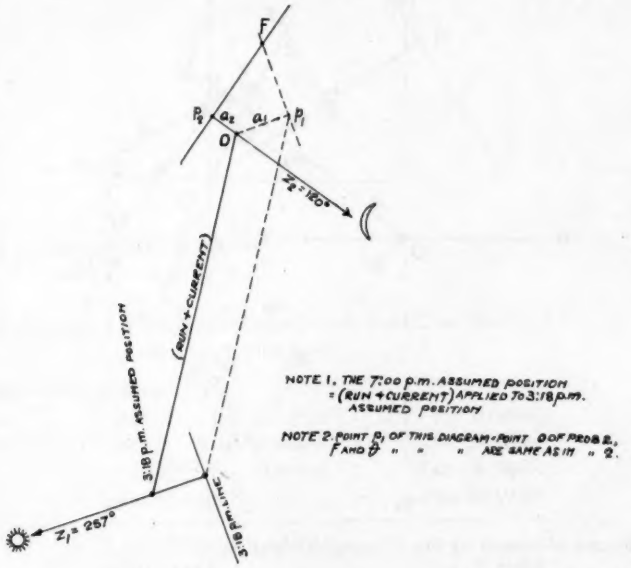
θ=12°, b_1=1.74 mi.

7:00 P.M assumed pos.,.....L 36°−10′.7 N, λ74°−06′.9 W

b_1=1.74 mi., C_1= 73°,.....l_1	0.5 N, D_1	2.1 E (p_1=1.66)
b_2=1.74 mi., C_2=175°,.....l_2	1.7 S, D_2	0.2 E (p_2=0.15)

7:00 P.M. fix.....L 36°−09′.5 N, λ74°−04′.6 W.

Problem 14 (*Compare with problem 2.*) 3:18 P.M. 28 April 1923, sun sight worked for assumed position L 36°−25′.7 N, λ74°−32′.9 W, gave $a_1=2.0$ mi. *away*, $z_1=257°$, $z_1+\pi=77°$, line 347/167°. Thence ran 37 mi. course 10° true, current one mile per hour set 77°, till 7:00 P.M., when moon sight worked for run-up assumed position L 37°−02′.9 N, λ74°−20′.4 W (=3:18 P.M. assumed position + run + current) gave $a_2=0.8$ mi. *away*, $z_2=120°$, $z_2+\pi=300°$, line 210°/30°.


F
P_2
a_2
a_1
P_1
O
$Z_2=120°$
(RUN + CURRENT)
3:18 P.M. ASSUMED POSITION
7:00 P.M.
$Z_1=257°$
NOTE 1. THE 7:00 P.M. ASSUMED POSITION = (RUN + CURRENT) APPLIED TO 3:18 P.M. ASSUMED POSITION
NOTE 2. POINT P_1 OF THIS DIAGRAM = POINT O OF PROB 2., F AND O " " " " ARE SAME AS IN " 2.

Required: Compute 7:00 P.M. intersection fix F of the two lines.

Solution: 3:18 P.M. $a_1=2.0$ mi. *away*, $z_1+\pi=77°$

7:00 P.M. line runs..... $30°=C_1$

$\angle\theta=47°$, $b_1=2.93$ mi.

7:00 P.M. $a_2=0.8$ mi. away, $z_2+\pi=300°$

3:18 P.M. line ran..... $347°=C_2$

$\angle\theta=47°$, $b_2=1.17$ mi.

7:00 P.M. assumed position...L 37°−02′.9 N, λ74°−20′.4 W

$b_1=2.93$ mi. $C_1=30°$.....l_1	2.5 N,	D_1	1.8 E ($p_1=1.47$)
$b_2=1.17$ mi. $C_2=347°$.....l_2	1.1 N,	D_2	0.3 W ($p_2=0.26$)

7:00 P.M. fix.....L 37°−06′.5 N, λ74°−18′.9 W

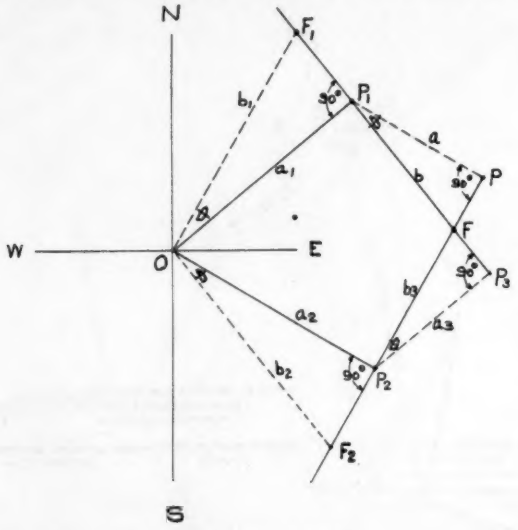
III. Precise relation between brought-up and simultaneously-applied lines.

1. In the case of *simultaneously-applied* lines (Examples 13 and 14),

$\left\{\begin{matrix}\text{point of origin}\\ \text{assumed position}\end{matrix}\right\}$ = point O . . . . . of present diagram,

altitude-differences = $\overline{OP}_1$ and $\overline{OP}_2$ . . . . . of present diagram,

and the rt. $\triangle^s$. used = OP_1F_1 and OP_2F_2 of present diagram.



2. In the case of *brought-up* line (Examples 1 and 2),

$\left\{\begin{matrix}\text{point of origin}\\ \text{=nav. position}\end{matrix}\right\}$ . . . . *corresponds to* point P_1 (or P_2) of present diagram,

altitude difference . . *corresponds to* $\overline{P_1P}$ (or $\overline{P_2P_2}$) . . . of present diagram,

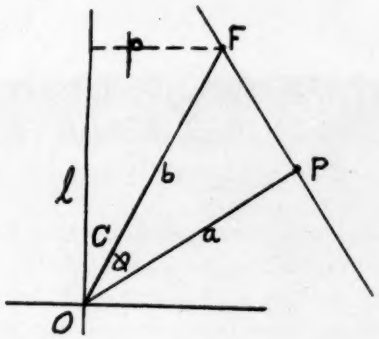
and rt. $\triangle$ used . . . . . *corresponds to* P_1PF (or P_2P_2F) of present diagram.

3. The point of origin (nav. position) used in case of brought-up line (Examples 1 and 2) therefore in actuality corresponds to point P_1 (or P_2) of present diagram, although it was lettered O in those examples (being the point of origin or assumed position *then* under consideration), for convenience and purpose of similarity in method.

4. It is to be noted, in present diagram, that $\angle PP_1F = \angle P_1OF_1 = \angle P_2OF_2$ $(= \angle P_3P_2F) = \theta$ and is acute and that $P_1P(=a)$ is $\|$ to, but does *not* equal, $\overline{OP}_2(=a_2)$; etc. (This explains, for instance, why a of Example 1 above, differs in value from a_2 of Example 13, while θ, on the contrary, *is* of the same value in both.)

IV. *The logarithmic solution.*

In case traverse tables not available, or for greater refinement of calculation:



Take θ, and determine C, as before;

Then (1) $l = b \cos C] = a \sec \theta \cos C$,

$b = a \sec \theta$

and (2) $D = p \sec Lm] = b \sin C \sec Lm] = a \sec \theta \sin C \sec Lm$.

$p = b \sin C \qquad b = a \sec \theta$

Example,—Prob. 1 above:

$a = 1.4$	log 0.14613.....	log 0.14613
$\theta = 12°$	l sec 10.00960.....	l sec 10.00960
$C = 175°$	l cos 9.99834.....	l sin 8.94030
$Lm = 36° - 10'.2$	.....	l sec 10.09298
$L = 1.42584$	log 0.15407	
$D = 0.15453$.....		log 9.18901

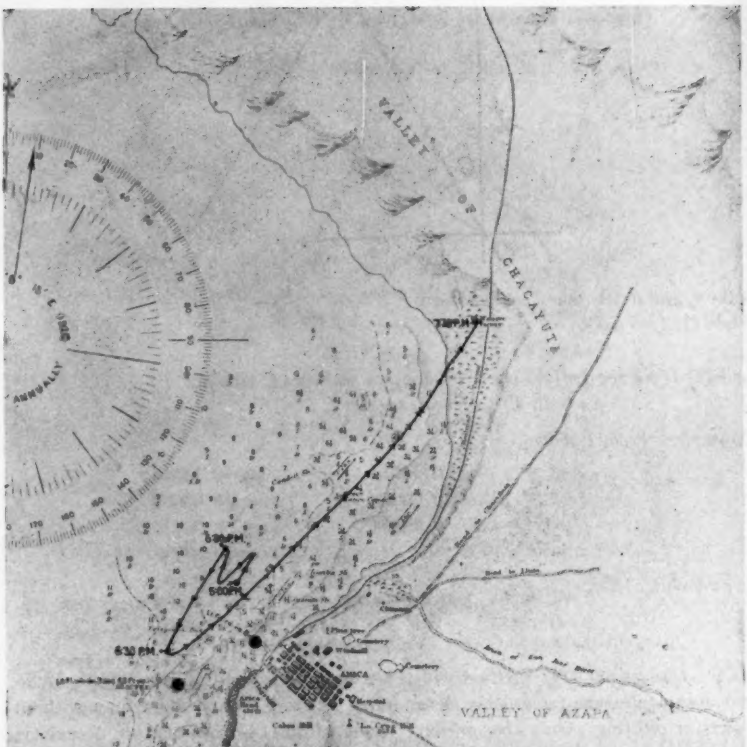
V. *Discussion.* The method which has been presented gives a definite, facile, and accurate means for quickly determining fix from Saint-Hilaire lines without charts or plotting. Only the ordinary traverse tables or formulae are necessary, and these are used only as ordinarily. The method is equally applicable to brought-up lines, to simultaneous and simultaneously-applied lines, and to several special uses (See Examples 5, 6, 10, 11, 13, 14, above); and no special rules are necessary other than the obvious and easily remembered.

(a) If an a is *away*, take its direction $= z + \pi$;

(b) Choose that direction (which thus determines the C concerned) of the brought-up or secondary line b, which is nearest direction of a;

(c) Auxiliary $\angle\theta$ must always be $< 90°$; this *checks* whether the C has been properly chosen.

The method should prove a useful adjunct in determining and checking the *exact* L and λ of fix, even when the lines are plotted.


VALLEY OF CHACAYUTA
AMBO ALLY
6:30 P.M.
5:00 P.M.
ARICA
VALLEY OF AZAPA
TRACK OF WATEREE FROM 6 P.M. TO 7:30 P.M.
Nautical Miles
SOUTH AMERICA
CHILE
ARICA ROAD

THE TIDAL WAVE AND EARTHQUAKE AT ARICA, PERU, IN 1868

By Captain J. K. Taussig, U. S. Navy

WE HAVE recently been hearing much about the small city of Arica, Chile, this owing to the fact that it is the headquarters of the commission appointed by President Coolidge for settling the long disputed question between Chile and Peru over the sovereignty of the Tacna-Arica provinces.

The fact that General Pershing and his associates have been living in Arica for some months has made the name more or less famous to the present generation. Few of them realize, however, that a little more than half a century ago, here occurred a cataclysm of nature in the form of a tidal wave and earthquake that left its impress on the entire world. The older officers of our Navy, at least those on the retired list, remember it well, as two of our men-of-war, the *Wateree* and the *Fredonia,* were anchored in the roadstead on that memorable day.

The writer is taking upon himself to bring to light some of the history of this event. This for two reasons.

Three years ago I happened to be in command of the cruiser *Cleveland,* stationed in the Canal Zone, when the earthquake and tidal wave of December, 1922, occurred about 500 miles to the southward of Arica. Under the command of Rear Admiral W. C. Cole, U. S. Navy, the *Cleveland,* and the *Denver,* Captain Y. S. Williams, were rushed to the stricken region with aid for the sufferers. While in Santiago, after our work had been completed, we found the newspapers full of the account of the Arica affair of fifty-six years previous. In one paper there was a picture of the *Wateree,* one of the American ships, taken in the position where left by the great tidal wave. When I told the editor of the paper that my father, the late Rear Admiral Taussig, U. S. Navy, was on the *Wateree* as a midshipman when she was wrecked, he was much impressed with the coincidence that it was an earthquake that brought the son to Chile fifty-eight years after a similar affair

had stranded the father there. He presented me with a copy of the photograph which is reproduced here. The *Wateree* is in the foreground. The wreck of the Peruvian corvette *America* is the other vessel.

This coincidence and photograph are not in themselves considered sufficient excuse for this account. The other reason is that not long ago, inspired by the article of Captain Knox on the subject of "Our Vanishing History and Traditions," I was looking over some old papers of my father and among them found a letter to his parents written in lead pencil immediately after the earthquake. With this letter were extracts from the log of the *Wateree*. These two papers, taken together, give such a vivid and accurate account of what happened that I feel they are worth reproducing in full. In reading the letter of Midshipman Taussig to his parents, it should be borne in mind that he was just twenty years of age and had but recently graduated from the Naval Academy.

EXTRACTS FROM THE LOG OF THE "WATEREE"

Log of the United States Side-wheel Steamer *Wateree*, 3d rate, 12 guns, Under the Command of Commander James H. Gillis, U. S. Navy, Bay of Arica, Thursday, August 13, 1868.

Record of Miscellaneous Events of the Day

Commences and until 4 a.m. Overcast, light breeze from northward and westward, smooth sea.—SAMUEL BELDEN, *Acting Master*

From 4 to 8 a.m. Light westerly airs and calm, smooth sea, overcast. Received for crew 149 lbs. beef, and 89 lbs. vegetables.—M. L. JOHNSON, *Lieutenant-Commander*

From 8 a.m. to meridian. At 9:30 inspected at quarters; exercised 1st, 3d, 4th and master's division at small arms; 2d division with single sticks; marine guard with small arms. Clear and pleasant, calm and light airs from S.W. Shifted port battery to starboard, and commenced scrubbing bottom in port side. At 12 m. 6 mechanics left ship.—JOHN BRANN, *Acting Ensign*

From meridian to 4 p.m. Clear sky and pleasant breeze from Sd. and Wd.—SAMUEL BELDEN, *Acting Master*

From 4 to 8 p.m. Commences with clear and pleasant weather; smooth sea and light breeze from S.W. by S; barometers at 30.14; att'd and dry bulbs 66°. About 41 10th blue sky, the rest clouds of stratus formation. At 5:05 p.m. experienced heavy shock of earthquake, which lasted 10 minutes, accompanied with a low rumbling sound, and causing the ship to tremble violently all over, and saw portion of the Morro fall away, the houses on shore tumbling down, and the town enveloped in a cloud of

dust. Immediately shifted over port battery, and secured both batteries for sea; battened down all hatches, stern chain ready to slip; port anchor ready to let go, and chain ready to veer away. Lowered away all boats in order to send assistance on shore, but which soon became impossible. At 5:32 the sea commenced to rise rapidly and the ship in violent current setting along beach to Nd. and Ed. dragged the anchor, let go the port one and veered away chain, which brought her up; stationed hands at the wheel. About this time the mole was submerged, and the sea had come up to the houses nearest the beach, the people rushing to the Morro; after several minutes there was a sudden reflux and the ship swung to seaward; sheering her with the helm to keep the chains clear; veered away more chain, ship having now 90 fathoms on starboard and 75 on port. A bark and brig in shore of us were left aground. After a lapse of a few minutes the sea rushed in again; veered to 95 fms. on port and 100 on stb'd. It was now near six o'clock; the brig was washed ashore and the bark on her beam ends a wreck. The Peruvian corvette *America,* U.S.S. *Fredonia* and English bark *Chanarcillo* and this, were the only vessels now left holding on. After a little time the sea again receded, the undertow washing brig again into the harbor, leaving her still aground. 'There was an ebb and flow of the sea after this for some little time; the water was covered with floating debris; several shore boats with people in them were picked up in drifting past us, and one boat with 8 men from English bark *Chanarcillo.* A little before 6, Mid'n Taussig in 1st cutter, was sent to the relief of a drowning man floating past us. At 5:20 Captain Gillis left the ship to render assistance on shore. Between 6:30 and 7 there was another tremendous rising of the sea, and at the same time on shore a terrible noise was heard, as of a tremendous roar of musketry, and lasting for several minutes. On the sea receding, the ship was swung violently to seaward, and after holding on for a minute or so, the deck stoppers parted, the chain flew rapidly out of the hawse pipes, tearing away compartments between the lockers, and being both shackled together, fetched up on the bight underneath spar deck between two hawse pipes. The ship now commenced to drift very rapidly to seaward, and was very near Alacran Island, but clear of it, when the sea commenced to rush very suddenly in again. The ship swung violently around again, and in doing so, just cleared the English bark *Chanarcillo,* when a strain came on the chains again; the st'bd one parted close to the hawse pipes, and ship drifted rapidly towards shore. About this time saw *America* go over on her beam ends, and terrible groans and cries proceeding from her; English bark *Chanarcillo* was also on her beam ends. The sky was now completely overcast, and the darkness was made greater by clouds of smoke from the *America;* which vessel had fires lighted and was getting up steam. About 6:55 ship among the breakers, and several heavy seas broke over us, but doing no other injury than throwing ship on her beam ends (she quickly righted again) and breaking in paddle box, bending portion of rim and braces of st'bd wheel, and jamming it against side, and storerooms on guards forward, and part of starboard hammock netting. Life lines were now got up

U. S. S. "WATEREE" ASHORE AT ARICA, PERU

The *Waterce* was carried nearly half a mile inland and more than twelve feet above high water mark by the tidal wave of August 13, 1868. The ship in the background is the Peruvian corvette *America*.

fore and aft; shortly afterwards the wheel ropes parted; several seas came in after this, and at about 7:20 we found ourself aground close up to a high bank, about 470 yds. above high water; once or twice during rest of the watch the sea approached us, but not high enough to float the vessel when first beached; the ship was lying almost broadside to sea coming in, but finally was washed around until the ship's head law W. ½ S. by compass, and head on to beach. Lost every boat except dinghy. During ebb and flow of sea wheels turned very easily and added no strain to the chains. Sounded pumps frequently during time of being washed ashore, but did not find water to cause any apprehension of a leak. Heavy shocks of earthquake were felt at short intervals from time of occurrence of first one. Sentry was posted over stores in wardroom when ship became endangered.—JOHN BRANN, *Acting Ensign*

From 8 p.m. to midnight. Ship lying high and dry most of the time; sea occasionally rising to a short distance above her, but not sufficiently high to have any effect on her. Shocks of earthquake were felt at short intervals, at least as often as once in twenty minutes, some of them were quite heavy. Sent two officers and five men to Arica to find and report to captain, to render assistance if in their power. 9:30 heard the crew of the Peruvian corvette *America* pass by, four of the officers of the *America* that were injured, were brought on board and cared for to the best of our ability.—SAMUEL BELDEN, *Acting Master.*

Examined and found to be correct.

M. L. JOHNSON, *Lieutenant-Commander and Navigator*

Friday, August 14, 1868

Record of Miscellaneous Events of the Day

Commences and until 4 a.m. Experienced repeated shocks during the watch; sky overcast.—A. WESTON, *Acting Master*

From 4. a.m. to 8 a.m. Experienced shocks of earthquake at short intervals during whole watch. At daylight found vessel close up to railroad track, high and dry, between 2 and 3 miles of and bearing N.N.E. of Arica Head, above high water mark. Corvette *America* ashore about 450 yds. W. ½ N. of us above high water mark, with screw carried away and rudder, and only main and mizzen lower masts standing; English bark *Chanarcillo* between us and *America,* a complete wreck. A brig with masts standing high and dry above high water mark to Sd. and Ed. Nothing of the *Fredonia* in sight except what was supposed a portion of her, with two men in it, and who were subsequently taken off, and a quantity of stores belonging to her. The beach strewed with wreckage of every description. Sent a party to search for dead bodies washed ashore. Overcast and calm, heavy surf breaking on beach, but outside calm. Dennis Lynch (seaman), one of 1st cutter's crew, returned on board.—JOHN BRANN, *Acting Ensign*

From 8 a.m. to meridian. Experienced slight shocks of earthquake at short intervals. Crew employed collecting provisions from off the beach; distributed provisions to sufferers.—SAMUEL BELDEN, *Acting Master*

The *Waterce* was carried nearly half a mile inland and more than twelve feet above high water mark by the tidal wave of August 13, 1868. The ship in the background is the Peruvian corvette *America.*

From meridian to 4 p.m. Experienced slight shocks of earthquakes at short intervals. Crew employed as in preceding watch.—A. WESTON, *Acting Master*

From 4 to 8 p.m. Experienced slight shocks of earthquakes. At 6:00 all hands went on shore to camp, per order commanding officer, leaving a sentry at the stern of the vessel.—SAMUEL BELDEN, *Acting Master*

Distributed, as per order commanding officer the following provisions during the day, to sufferers:—200 lbs. beans, 300 lbs. rice, 60 lbs. coffee, 800 lbs. biscuit.

Examined and found to be correct.

M. L. JOHNSON, *Lieutenant-Commander and Navigator*

LETTER OF MIDSHIPMAN TAUSSIG TO HIS PARENTS

U. S. Steamer *Wateree*. Stranded near Arica,
August 21, 1868

DEAR PARENTS:

How to describe the terrible change which occurred here in a few hours, nay moments, on the 13th of this month, is a task too difficult for me to accomplish, yet knowing how desirous you must be, I have taken the earliest opportunity of jotting down some of the events.

About 5 o'clock on the 13th, we experienced a shock of earthquake, accompanied with a low rumbling noise which first gave us warning of its intensity. The shock at first was very gentle, so as barely to make the ship tremble, but gradually increased so that we were soon in violent commotion. Upon rushing on deck, we saw great masses of the Morro (a white cliff which protects the town from the S.W. winds which generally blow here) fall into the sea; then the houses began to tumble down, the people to flee towards the hills and the plaza to escape being buried amongst the ruins of the houses. The shock lasted about ten minutes, and destroyed about half the town. The sea then slightly recoiled, but in a few minutes again rushed in with immense velocity, its course being along the beach. It carried everything before it, and being accompanied with another shock more violent than the first one, every house in Arica but two were either washed away by the sea, or shaken to the ground by the shock. A great many of the people had crowded in front of the custom house and on the mole, and some sixty of them are supposed to have been carried away by the current which totally submerged the mole, for upon the sea receding neither they nor the least sign of the mole was to be seen. Immediately after the second shock, a man crying for help was seen, upon a mass of earth and weeds, drifting by us, being carried along by the current which was running with great swiftness. Immediately after the first shock all the boats were lowered and one of them, the 1st cutter, was manned. Upon hearing the cries of the man on the float, Mr. Stuyvesant asked for an officer to go in the cutter, so I volunteered, and as soon as the boat could be hauled alongside, or rather under the stern, I let myself down into her, cast off, and letting go the painter (the rope which attached us to the ship)

pulled in the direction from which his voice was heard. But by this time he was far beyong the reach of our aid, and the sea receding again with great violence, we barely escaped being carried to sea. Fortunately we brought up close alongside the *Wateree* again, and a rope thrown to us was made fast to our bows. The scene now was fearful,—the town and Morro enveloped in smoke and dust, for the houses falling down started three or four fires around town. The swiftness of the current had carried us about a mile to the Nd. and Ed. of our anchorage; a brig inshore of us went on the rocks, and a bark with American colors was on her beam ends. The sea always came in from the Sd and Wd, and went out to the Nd and Ed. During a part of the time a strong breeze blew from the Sd and Wd also. The *Fredonia* and the Peruvian corvette *America* until then had still held their ground. An English bark, the *Chanarcillo,* was being dragged in the same direction as we. The sky was overcast so that at six it was perfectly dark. The ship had now two anchors down, with about 100 fathoms (600 ft.) to each chain. The chain of the *Chanarcillo* rushed out with such speed as to strike great flashes of fire in passing through her hawse pipes. The sea came in in immense waves, so that in the cutter, for I was still hanging to the stern of the *Wateree* by the rope that had been thrown us, the spray wetting us completely and rocking so violently as to be in danger of capsizing. Violent shocks were felt every few minutes, keeping everything in commotion. The sea was covered with debris of the wreck,—houses, railroad cars and tracks, boats, men, dogs, trees, logs, etc., were rapidly carried past us, first one way and then the other; the boats made fast to the ship had great difficulty in keeping clear of the driftwood. About half-past six p.m. the rope which had held my boat to the ship broke, leaving us adrift. For a few seconds I was in great uncertainty whether to go to sea, make for the *Fredonia,* or for the *America.* The waves and currents decided for the *America,* so that with all our pulling, and I rendered willing hands to the stroke oarsmen in order to make sure that all hands kept one stroke for if any had failed, we would immediately have been drowned. I never pulled so hard in all my life, and although it could not have been more than two or three minutes before we were under the stern of the *America,* I had but little breath left in me to go through the rest of my adventures. The Peruvians cast us a small line which with our oars pulling kept us pretty close under her stern. The helm was of little use as the sea was now in such a ferment that it was impossible to tell from where the current did not come. The Peruvians then threw us another line which we made fast, and then seeing that it was impossible for the boat to live in such a sea, I ordered the men to climb up, which they did as rapidly as possible. We had a good deal of slack rope and the sea would sometimes bring us close under the *America's* counter, and then would tauten out the line to its full extent. As we always came alongside with a thump we soon sprung some of the planks, the boat was half full of water, the line was taut, and there were still three men in the boat besides myself. "For God's sake give way" I cried, and with four oars out we pulled with all our might. The Peruvians had another line out for us which two of the men grabbed,

leaving the coxwain and myself in the boat, which brought up against the *America's* quarter with such violence as to fill the boat immediately. The coxwain and I had barely time to grab the rope holding the boat ere it parted beneath our feet, leaving us suspended between wind and water, the coxwain above me about eight feet. Owing to the want of presence of mind on the part of the Peruvians the rope was not hauled up as rapidly nor as steadily as it ought to have been, so that we were three times lowered into the water, which was rushing past us at the rate of eight or ten knots per hour. I managed to get one of my feet around the rope, so held on very securely, although I had fears that the rope might chafe on deck when I would inevitably have been drowned. They finally hauled us half way up, let down another line, and some of my crew catching hold, we were soon safely landed on deck. We had hardly touched the deck ere I heard a dull sound, felt the vessel shake and knew that we were aground. All this while the vessel was rolling fearfully. The crew (of the *America*) were crazy with liquor and clamoring for more, in fact, both vessel and crew were unmanagable. The captain of the *America* was drowned a few minutes before I came on board, and the first lieutenant could not make his voice heard above the roar of the waves and the wailing and crying of his crew, until he finally gave it up in despair and wept. Having recovered my breath I descended from the poop to the spar deck on the starboard, or right-hand, side, but a wave sweeping the ship took me first against the ship bulwarks, barely escaped a port, then against the cabin bulkhead with such violence that I could hardly stand for some time after. One of the guns being nearly adrift, my boat's crew secured it, and then with me repaired to the poop and kept well together in the mizzen rigging. The *America* thumped with such violence and was so often swept by the waves that I told my men to go aloft and lash themselves to the top. The ship was very much canted to port, so we all crowded together to starboard. She righted, however, and being steady for a few minutes I noticed that her rigging was so strong that it would be sure to hold, so concluded that we had better go below again. As soon as we reached the deck the chief engineer came to me, begging me to go with some of my men into the fire-room, as there was one of the engineers jammed between the boilers and that the fires were scattered everywhere around the fire-room. Much as I would have liked to have done so it was too dangerous and fool-hardy for anyone to have gone below on such an errand, so that I had to refuse. All this while the ship was drifting in towards the shore, thumping and bumping along the bottom. A light was still burning in the wardroom; fearing an explosion, the chief engineer asked me to go down by a rope and put it out. Although I did not like the job, especially as there was a lot of Peruvian officers and men around me, for my own safety I went down, but could not reach the lamp as they did not give me rope enough, and the sea breaking in at that moment extinguished it. Our lives were not worth a farthing at this time. The cries of the crew were fearful. The lights of the *Wateree* were in sight and the yells with which she was hailed by the drunken crew of the *America* were such that even now

they ring in my ears, filling me with madness, for I knew that they were useless, that all the *Wateree's* boats had been swept away, and even had she had the boats the sea would have swallowed them up.

Soon after, the foremast went by the board and the main topmast followed. Fearing that the mizzen would go also, the boat's crew and I huddled together on the poop deck holding on to the back stays. I fortunately found a small piece of rope, what is called rattling stuff, with which I lashed myself to the royal backstay. The ship was canted to starboard, so we all kept to port. We were now hard aground, yet the sea continually swept us fore and aft. I now began to feel pretty secure, as unless the sea rose again, which I did not think of, the ship would remain where she was all right, being an extraordinarily strong one. Suddenly the sea receded, and we were left without an inch of water under us. After discovering that the sand was hard, all of the boat's crew except two, left the ship with me. We got in two ranks, grasped hands so as to haul up stumblers and help the weak, and then we ran for life, for the sea was coming in again, fortunately not with great velocity, so that we reached dry land after a run of about half a mile. A tramp of about four miles brought us to Arica, where on the hills I found Captains Gillis and Doty. Several other of the officers were on the hill waiting for news of their ships and aiding the wounded. Mrs. Johnson, the wife of Lt. Comdr. M. L. Johnson, was killed by the first shock; her death was instantaneous. She was much liked by all of us, and had intended to go home (Lynn, Mass.) in a month or two.

The next morning I returned to the *Wateree,* found her about 500 yards above high water mark, and twelve feet above the level of the sea. The tidal wave, by measurement, was forty-two feet high.

I have been hard at work every day, standing watch, kidnapping mules, getting water and burying the dead. All of the *Fredonia's* crew are lost except the captain, doctor, paymaster, and two of the crew, who were washed ashore alive.

I have written most of this by the camp fire and have not time to revise or correct it.

The *America* is right ahead of us, near the water's edge. The bark *Chanarcillo* is a complete wreck a little off our starboard bow. *Fredonia* and another bark have been so broken up that there is hardly a plank left to show where they were cast ashore. A brig is upright about half way between here and Arica. Every vessel in the harbor was cast ashore. I have no idea what they will do with us.

22d. The *Kearsage* and *Nyack* are in the harbor; have not yet heard from them.

Hoping that you have not undergone any anxiety about me, I remain....

EDWARD

On the chart of Arica Roads I have attempted to trace the course of the *Wateree* from the time the earthquake began at 5 P.M. until the worst part was over at 7:30 P.M. The course laid

down can be only approximate. This is due to the facts that it became dark shortly after the ship began to drag, and there is no evidence that any fixes were obtained during the perambulations. It is probable, also, that the log for the 4 to 8 P.M. watch was not written up until the following morning. So it can safely be taken for granted that the course of the *Wateree* during these two and a half hours was much more irregular than depicted on the chart.

It is apparent, however, from a study of the log, that the ship gyrated back and forth in the vicinity of its original anchorage with each ebb and flow of the sea. Then when both anchor chains were out to the bitter ends and a part of the structure of the ship had been carried away forward, the ship was carried close to Alacran Island, where only good luck saved her from being dashed to pieces. While in this position there came rushing in a sea much larger than the previous ones. The starboard anchor chain parted and the ship was carried rapidly to the northeastward, finally coming to rest in the position marked on the chart as Wateree factory.

The *Wateree* was evidently of good substantial construction. Her hull was made adaptable for living purposes and for some years she was used as an inn. Perhaps some officer who reads this paper and has occasion to visit Arica in connection with the Tacna-Arica Commission will visit the building marked on the chart as Wateree factory, and inform the Institute readers whether any traces of the *Wateree* still remain.

I remember one rather amusing incident my father used to mention in connection with the mules which were kidnapped. The *Wateree* being high and dry, there was, of course, no need for boats, even had they been spared by the elements. The mules were accordingly used for carrying on much of the ship's work that would ordinarily fall to the lot of the boats. So the lower booms were rigged out, and the mules, when not in use, were hitched to the laniards. While most of the crew were encamped on shore, the mule caretakers lived on the ship. It soon became the custom to call away the "First mule," or the "Second jackass," and so forth, and the sailors became expert in running out on the booms, down the laniards, and on to the mules' backs without a foot touching the ground.

* * * * *

This great earthquake and tidal wave in 1868 appears to have been the forerunner of a series of misfortunes which reduced Arica from a flourishing city of 30,000 inhabitants to a town of not greatly in excess of 2,000. In 1880 the Chilean Navy bombarded the city and then ransacked it. In 1906 there was another earthquake which did considerable damage, but not nearly so extensive as the one of thirty-eight years before. During the last twenty years Arica has gradually been recovering from its misfortunes. Its population now approximates 10,000 and is increasing. This increase cannot be attributed in any way to the attractiveness of the neighboring country. The only tree in the entire vicinity is sufficiently conspicuous in its barren surroundings to warrant the map makers indicating its presence. Arica gets its increasing importance owing to its anchorage being the best in that locality, and owing to the fact that it is the tide-water terminus of the Tacna and of the LaPaz railroads. In fact practically all of Bolivia's overseas imports and exports pass through Arica.

It therefore looks as if Arica may look forward to a continuous growth which will bring the city back to the size and importance it enjoyed in the middle of the nineteenth century. This certainly will be the case when the Tacna-Arica dispute between Chile and Peru is finally settled, and if the city is spared future great disturbances such as the great earthquake and tidal wave of 1868.

SEA WORDS ON SHORE DUTY

By Professor Allan Westcott, U. S. Naval Academy

IN MOLIÈRE'S *Le Bourgeois Gentilhomme* the leading character expresses great surprise when he is told that all his life he has been talking in the strange language called prose. Many shore dwellers, I imagine, may have a similar feeling when their attention is directed to the multitude of words in their everyday speech which come from the language of the sea. Some of these words, to be sure, betray their salty origin, but most of them are used with no thought of the fact that they are sailor phrases which have long ago drifted ashore.

Collecting these phrases, picking out instances of their use in literature old and new, hunting down their origins in the *Oxford Dictionary* and more recondite sources, has for several years been one of the writer's hobbies. Not infrequently he has discovered a nautical origin for phrases that, prior to investigation, he never realized were nautical at all. Many of these sea terms recall forgotten habits of speech and ways of doing things that belong to the age of the oar and the sail, and their nautical antecedents may be unfamiliar even to expert employers of "seagoing" language today. One and all, they afford striking evidence of the extent to which the English speaking people, from the ocean rovers who first brought our speech to its island home down to those who have carried it to the ends of the earth, have been followers of the sea.

Similar evidence of course appears in our literature, in its wealth of sea poetry and sea fiction. At the same time both our literature and our language show that the sea interest has not been present in equal measure in all periods of English history. Masefield has said, "Until the end of the 18th century our poets hardly saw the beauty of the sea, though they felt its terror." And of most of the sea poetry between the poignant and realistic sailor's lament of the *Wanderer* in Anglo-Saxon and Byron's *Childe Harold* one might affirm that it was written by people who knew the sea chiefly by living on its shores.

Likewise the fact that most of our nautical words are of Dutch origin, with a scattering from Spanish and Scandinavian sources, speaks of the several centuries, in the formative period of our language, when other powers than Britannia ruled the wave. As for the taking over of sea terms into the common speech, although such adoptions occurred in Elizabethan times, they date more frequently from the period of England's immense commercial expansion in the 17th and 18th centuries, and her corresponding development of shipping and naval power. In a surprising number of instances the adoption has taken place on this side of the Atlantic, reminding us of the days when the American merchant marine rivaled England's, when our whalers and clippers sailed the Seven Seas, when, in the words of Burke, there was "no sea but what was vexed by their fisheries, no climate but what was witness to their toils."

It is to this early maritime interest, no doubt, together with the wide use of the steamboat in early days on American rivers, that we owe the application in this country of a number of nautical terms to commerce on land—terms which have other equivalents in purely British usage. For instance, the word *freight,* for "goods" whether shipped by sea or by land, is in earlier and in British usage confined to ship's cargo. The verb *ship* just used, as well as *shipper* and *shipment,* is also an Americanism when applied to land transit; and we use these words with no sense of the incongruity of shipping a shipment on cars.

On our passenger trains the conductor shouts "All aboard" and we get "on board" for an altogether inland voyage. If we can afford it we may take a *stateroom,* not realizing that this high-falutin word for our cramped quarters goes back via steamboats and sailing ships to the captain's and officers' quarters—the "rooms of state"—on 17th century men-of-war. If we take only a *berth* we are still linguistically at sea, for *berth* is a nautical word connected in some obscure way with the nautical meaning of the verb *to bear.* Even on our freight trains the *caboose* (Dutch *kabuis*) is named after what was once a small galley or cook-house on a ship's deck. And the very *ballast* on the track is so called because it is of similar material to ballast (Old Danish *barlast* = "bare or mere load") in ships. Some say more definitely that it was so called because early railroads in England were constructed with actual ballast brought back to Newcastle-on-Tyne by colliers returning from the Thames.

To cite less easily recognizable adoptions, the meaning of the word *bulk* was once confined to a ship's cargo taken as a whole, and this earlier meaning is still clearly suggested in such phrases as "to break bulk" and to load or sell "in bulk." *Average,* one of our commonest words, came into English from the sea as a Mediterranean or Levantine name for a tax or duty; it was later, and still is, applied to a levy, divided equitably (averaged) among owners of ship and cargo, for losses suffered at sea; and from this it passed naturally into its present multiplicity of uses.

Rummage and *junk,* either as nouns or verbs, do not sound very seagoing. But in Elizabethan times *rummage* (from Old French *arrimage* or Spanish *arrumage*) was the word generally used for stowing or overhauling cargo, especially casks of wine, and the like, in a ship's hold. An old Admiralty Report of 1544, quoted in the *Oxford Dictionary,* speaks of "the romeger whiche they appoynted . . . . to romege caske wares in the said shipp." Shakespeare puts the word into Hamlet's comment on the "post-haste and romege in the land" of Denmark; and he is here using the word, I feel sure, to signify packing and stowing of supplies for an expedition, practically in the sense given above. Later the word was applied to customs officers' search of vessels, and there were "rummage sales" of seized articles—all of which helps to explain our modern use of the word for both a noisy, bustling search and a collection of odds and ends. The word *junk,* as we now use it in *junkshop, junk-dealer,* and so forth, was originally a sailor's word applied as early as the 15th century to old ropes and cordage. *Junk,* as the name of a Chinese sailing ship, is an entirely different word of eastern origin.

Naval warfare, as well as peaceful commerce, has furnished its quota of words for use on shore. One of the most remarkable of these perhaps, is the phrase *first rate.* Englishmen now call this a "Yankee" idiom, and an English traveler once said it was so widespread in this country that even the Indians, when asked about their health, would always answer, "Fuss rate." It came into use, however, in England in the 18th century, and was undoubtedly suggested by the early classification of British naval vessels as first-rates, second-rates, and so forth, up to fifth-rates. The beginnings of the process by which the phrase became a superlative in everyday speech may be illustrated by a passage from Farquhar's play *The Recruiting Officer,* written in 1706. "She is

called the Melinda, a first-rate, I can assure you," says one of the characters in identifying a young lady who appears in the offing, and he then offers to capture her as a prize. It is strange that the word should have become so popular in America, for there were no first-rates, or ships of the line, in the United States Navy until after the War of 1812, but the prevalence of the phrase in this country testifies to our early familiarity with naval affairs.

With *first rate* may be compared *A-1,* which is, or used to be, Lloyds' symbol for a ship in first class condition, the letter referring to the hull and the numeral to ship fittings and spars.

Close quarters is another common phrase of purely naval origin. *Close-quarters,* sometimes called *close-fights,* were movable timbers which could be set up on decks, especially of merchant vessels, to serve as barricades for retreat or defense when a vessel was boarded. Fighting "at close-quarters" and coming "to close-quarters" readily suggested figurative uses of the phrase. Another expression of naval origin is *skylarking,* as a synonym for "raising Cain" in general, and an especially appropriate word for youngsters' antics in the rigging of the tall three-deckers of a century ago. This word may be said to have official naval recognition, for American naval officers will recall that midshipmen at Annapolis are forbidden by academy regulations from "skylarking in corridors."

Among other phrases from sea fighting may be mentioned "to blow great guns," which apparently means to blow so hard that the cannon break loose below decks, with the results which Victor Hugo vividly describes in *Les Miserables;* "to sail under false colors" or "with colors flying"; "to clear the decks for action"; "to have not a shot in one's locker"; to make a hit "between wind and water"—at the water-line where it will do the most damage; to *soldier* or *sojer,* meaning to "lie down on the job," and expressing the sailor's old-time contempt for the soldier or marine at sea. *Broadside* and *broadside on* are of course naval, but they are by no means confined to naval uses. *Round Robin,* in the sense of a joint petition, first appeared in the British Navy, where it was adopted as a most appropriate name for sailors' statements of grievances which were signed by the ingenious device of putting the names in a circle, to avoid betraying the "ring-leader." *Lump sum* was also first used in speaking of sailors' pay, meaning specifically the payment of arrears at one time and not by instalments.

Most of the sea terms that have been taken over completely into the general vocabulary come to us from the early days of sail. Since the passing of the square-rigger, *taken aback* hardly seems course were originally sailors' terms describing the action of a square-rigged ship when the wind caught her sails on the wrong side and stopped her progress. *By and large,* another idiom which has spread beyond New England as a good substitute for "all things considered," gets its significance from the phrases used in nautical at all; and I have heard *to keep backing and filling* explained as referring to the actions of a balky horse. Both of reckoning a ship's qualities when sailing "by the wind," or close-hauled, and "large," with the wind fair.

Aloof and *to the bitter end* are both nautical, but both appear in other than nautical uses at least as early as Shakespeare. "I stand aloof," cries Laertes in the duel scene of *Hamlet,* "and will no reconcilement." The word *aloof* is an adverb formed from the verb *luff* or from its Dutch equivalent. "Stand aloof" is said to have been the usual order formerly given by men-of-war to strange vessels, requiring them to come up into the wind and keep their distance. As for *bitter end,* Captain John Smith's *Seaman's Grammar* of 1628 explains a *bitter* as "the turn of a cable about the bits," and the *bitter end* as "that part of a cable that doth stay within board." When the cable was paid out thus far, the ship was quite literally "at the end of her rope." The pun on the word *bitter* naturally helped the phrase to its wider circulation. For a contemporary nautical use of the phrase, see p. 1328, l. 11 of this issue of the PROCEEDINGS.

Like the words just mentioned, we nowadays use *mainstay* and *figurehead* with little thought of their nautical origin. In the case of another possible bit of verbal flotsam-and-jetsam, the word *chock-a-block,* this origin is perhaps not so certain; but *block* is unquestionably the sailor's word for pulley, the whole expression meaning "block-and-block," so that the blocks of a tackle are brought together. To take another example, *squilgee* or *squeegee* will no doubt pass muster as a sailor's word for a sailor's implement, but I should like to believe that it is coming into use, even outside of naval or nautical circles, as the name for the windshield wiper on an automobile. If this application of the word is not general, it might well become so, for a squeegee is exactly what a wiper is—a blade of rubber or similar material to scrape off water and mud.

The word *hail* is not nautical in all of its meanings, but it is used in its nautical sense in such expressions as "hail a taxi" and "Where do you hail from?" So also the word *pirating,* when applied to the stealing of copyright or other literary theft, is merely given an extension of its nautical meaning. Like pirate, our common word *rover* (from the same root as *reave* and the Scottish *reiver*) means properly a sea robber; and the verb *rove,* especially in such phrases as "a roving blade" and "a roving commission," seems to have taken its present broader meaning from this earlier one. Most of us will recall that Sir Ralph the Rover, in Southey's poem *The Inchecape Rock,* was a pirate. Other examples of nautical uses of words not in all senses strictly nautical appear in the phrases *to fall foul of,* meaning to run into or *foul,* and *to grapple with. Grapple,* either as a noun or a verb, appears in Shakespeare's *Twelfth Night,* where Antonio's sea fight is described as a "scathful grapple"; and it appears twice in *Hamlet,* once where the hero boards the pirate ship "in the grapple," and again where Polonius advises,

> Those friends thou hast, and their adoption tried,
> *Grapple* them to thy soul with hoops of steel.

Incidentally, if I were a Shakespearean emendator, I would strongly argue that *hoops* in the last line of this quotation was first written *hooks.* All three passages clearly suggest the use of grappling irons or hooks in early naval warfare, and it is from this practice that we get our modern *grapple with* in the sense of "wrestle with" or "grab."

Thus far the borrowings from sea language which we have considered have been in the field of reputable English, but there are many others when we move downward into the realm of colloquialisms and slang. *Diego,* which is Spanish for James, the patron saint of Spain, is at least several centuries old as a nickname for Spaniards or other members of the Latin races. It occurs in Dryden, and in this line from a play by Davenant as early as 1650:

> The Diegos we'll board and rummage in their hold.

Among sailors this use of *Diego,* or *Dago,* has always been current, and one scholar at least has attempted to account in this way for its reappearance in modern slang. At the United States Naval Academy its application to the French and Spanish (Dago) Department appears to antedate its use elsewhere in the country.

Other colloquialisms of more or less dignity and general currency are *shipsape, sail into* (cf. *inveigh,* the competent elements of which, *in* and *veho,* have much the same meaning in Latin), *turn in* for go to bed, *bilge* for nonsense (perhaps confined to British usage), *caulk off* for go to sleep (explained from an old sailor trick of sleeping on deck when pretending to caulk seams), and perhaps also *clipper,* when applied not only to ships but to anything trim and speedy. The word *clipper* can be traced naturally enough to the verb *clip,* and was no doubt applied to the fast American ships of the 1830-1860 period because of their sharp lines and neat movement through the water. Its extension to racehorses and also to "fast" ladies was a later development, and seems to have been suggested by its use in connection with ships. The opposite of a clipper would be a ship with *bluff* bows. And oddly enough, this word *bluff* has also come ashore, not only as the name of a precipitous shore-line or headland, as in *Council Bluffs,* but in many other familiar uses. In its poker and slang sense, the dictionaries trace its origin to another word *bluff,* meaning a blinder for a horse's eyes; but *bluff* is American slang, and most of us, I think, when we use the word in this slang sense have the picture in mind of a brazen, impassive countenance, like a bluff bow or a bluff shore.

If at this point we may pick another quarrel with the lexicographers, the verb *jibe,* in what Webster calls its "low" and the *Oxford Dictionary* its "American" sense of "to harmonize or agree with" (as, "That doesn't jibe with what you said a minute ago"), is not associated by the dictionary-makers with the nautical verb *jibe* or *gybe.* But those who know the satisfaction of having jib and mainsail "jibe" together will surely see a very natural connection between the nautical and the other meaning.

In the nomenclature of intoxication there has been such an extensive borrowing from sea words and metaphors as to cast a slight shadow on the old-time sailor's conduct on shore. *Grog,* as is well known, dates from about 1740, when Admiral Vernon, called "Old Grog" because of his grogram breeches, required his men to take their rum mixed with water instead of neat, and thus bequeathed his nickname—no doubt as a term of contempt—to the mixture. From *grog* was formed the adjective *groggy,* familiar in racetrack and ring-side slang. For drinking and drunkenness we have "to splice the main-brace," "half seas over," and "three

sheets in the wind." "Walking a chalk mark" is said to have been a sailor's test of inebriety, and the punishment for it was confinement "under hatches," whence, with a slight dialectical variation, comes our familiar phrase "under hack," for under duress or in jail.

So numerous indeed are the sea-faring metaphors in common speech that they can be little more than suggested. Such words as *land* (as a verb), *anchor, harbor, buoy, sail, list* (in the sense of *tip*), *pilot, steer, careen* (from the French word for hull), *capsize* (a late word which did not appear in the dictionaries until the 19th century, probably from Spanish *capuzar,* to load by the head) are all used constantly and in a great variety of figurative expressions. For illustration one need turn only to familiar hymns, from "Jesus Savior, Pilot Me" to "Pull for the Shore."

Some of these metaphors, such as "in shallow water," "beyond one's depth," "sink or swim," "keep one's head above water," and "break the ice," do not imply boats at all; they belong, so to speak, to the age of swimming or wading. Others, such as "pull together," "pull a lone oar," "put in one's oar," "back water," and "all in the same boat," may be said to date from the age of the oar. With these may be put the distinctly American contribution, "to paddle one's own canoe."

From steering and ship guidance in general we get such self explanatory metaphors or idioms as "to steer clear of," "to give a wide berth," "to take the helm"—often of "the ship of state," "to set one's course" or to be off it, "to box the compass," and "to speak by the card," *card* in this last phrase being the Elizabethan word for the dial of a compass, or, it may be, for a chart or map. Closely associated with navigation are "to lose one's bearings," "to give plenty of sea-room," "all at sea," "plain sailing," "the lay of the land," "breakers ahead," and "the coast is clear."

From sailing ship maneuvers come "to sail too close to the wind," "to take the wind out of one's sails," "under full sail," "take in sail," "to go off on a new tack," "to get to windward" of an opponent.

"Pouring oil on the troubled waters," though as old as Plutarch and the Bible, is not out of date either as a practical expedient or as a metaphor. Even a landsman may object to "the cut of one's jib." "Bear a hand" is nautical, and so is "know the ropes." We speak of "floating" a loan, turning some one "adrift," "tiding over" a crisis, taking someone "in tow." "Room to swing a cat"

sounds as if it referred to that nautical weapon, the cat o' nine tails. "When our ship comes home" is an age-old equivalent for "when our dreams come true." From a variety of nautical sources we get "flood of fortune," "on the stocks," "high water mark," "to stick like a barnacle," "to spin a yarn," to be "in the doldrums" (in low spirits), to be "stranded" or "on one's beam ends," to be "between the devil and the deep sea."

Professor Logan Pearsall Smith in an article on *English Idioms,* published by the Society for Pure English, counts eighty-six idioms drawn from the sea, as compared with fifty from the speech of soldiers. In his reckoning, however, he omits many of those given here. Whether other nations with a long maritime history, as for example Holland or Italy, show a similar wealth of sea phrases in their everyday language, is a question which it would be difficult to determine. From casual examination one might guess in the negative. Each language, however, can cite nautical idioms peculiarly its own, as, to take single examples, the Dutch *Hy heeft een vat zeil* (he has a wet sail), for "He is drunk"; the Italian *col vento in poppa* (with the wind astern), for "successful"; the French *être á fond de cale* (to be at the bottom of the hold), for "out of cash."

It will be noted that practically every one of the words and phrases thus far cited goes back to the days of oar or sail. From our own age of steam navigation, steel navies, and wireless, I can think of only a few scattered and doubtful phrases of general currency, such, for example, as *S.O.S., torpedoed, sit on the safety-valve,* and *blow one's whistle*—and there are whistles and safety-valves on shore as well as at sea. Even the handy word *gadget,* so familiar in naval vernacular, has curiously enough not yet broken into any dictionary, and it can hardly be said to have gone far beyond naval circles.

Does it take time for such words to work into general usage? Or is the explanation rather that life on the old sailing ships was more sharply differentiated from life on shore, giving rise to a language all its own, which made at the same time a fresh and romantic appeal to landsmen's ears? Whatever the explanation, it behooves the sea-faring profession of our own time to cultivate their peculiar vernacular and use it freely, on shore as well as afloat, for the sea idioms enrich our language. Like old sailors, they bring ashore with them the glamor of their voyaging and the salt savor of the sea.

HISTORIC SHIPS OF THE NAVY

By Robert W. Neeser

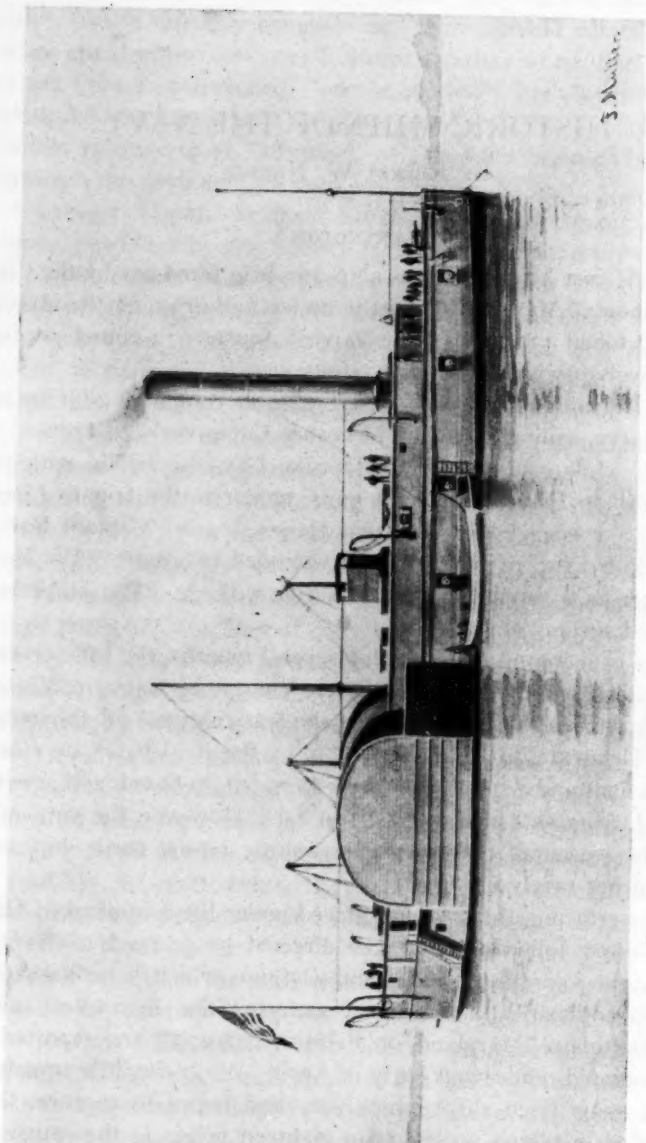
"Lexington"

THE first *Lexington* was a 16-gun brig fitted out by the Continental Marine Committee under authority of the Act of October 13, 1775. She carried fourteen 4-pounders, two sixes, twelve swivels, and eighty-four men.

The *Lexington* made her first cruise in command of Captain John Barry, sailing from the Delaware Capes early in 1776. On April 7, while cruising off Chesapeake Bay, she fell in with the British sloop *Edward,* of eight guns, tender to the frigate *Liverpool.* "She engaged us near two glasses," wrote Captain Barry. "They killed two of our men and wounded two more. We shattered her in a terrible manner, as you will see. We killed and wounded several of her crew."

After cruising on the coast for several months, the little cruiser was ordered to the West Indies, in charge of Captain William Hallock, but on the return voyage she was captured off the mouth of the Delaware, in December, 1776, by the British frigate *Pearl.* A lieutenant and a small prize crew were put on board, and seventy of the *Lexington's* men were left in her. However, the same evening the prisoners rose on their captors, retook their ship, and brought her safely into port.

After refitting, the brig was placed under the command of Captain Henry Johnson, who was directed to proceed to Nantes, France, to join the *Reprisal* and *Dolphin* which were harassing English commerce in European waters. The *Lexington* sailed from Baltimore, Maryland, on February 27, 1777, and reported at the appointed rendezvous early in April. While the little squadron missed some linen ships which they had hoped to capture, they succeeded in taking no less than eighteen prizes in the course of their circuit of the Irish coast. On June 27 they were chased off Ushant by a large ship of war, but all three cruisers succeeded in making their escape, the *Lexington* running into Morlaix, while



U. S. S. "LEXINGTON" (THE THIRD SHIP TO BEAR THE NAME)

her consorts put into St. Malo. "The three fellows have three of the fastest sailing vessels in the employ of the Colonies," wrote a British agent to the Foreign Office in London, "and it's impossible to take them unless it Blows hard."

About the middle of September, the *Lexington* again put to sea. Two days out, on September 20, 1777, she fell in with the British 10-gun cutter *Alert,* and a spirited engagement ensued, but the lightness of the vessels and the roughness of the water rendered the fire on both sides rather ineffective. After two hours and a half, Captain Johnson succeeded in crippling his antagonist's rigging, but in so doing he used up nearly all of his powder. Taking advantage of the *Alert's* condition, he made all sail in an endeavor to escape. But the British commander soon "got his rigging to right" and giving chase "came up with him at half past one, renewed the action till half past two, when he struck."[1] *Lexington* lost seven killed and wounded, while the enemy's casualties numbered only five men.

The second *Lexington* was an 18-gun sloop of war built at the New York navy-yard, New York, under the Act of March 3, 1825. She was launched in 1825, and was completed at a cost of $112,128. She was a sailing vessel of 691 tons burthen; 127 ft. length; 33 ft. 6 in. breadth; 15 ft. 3 in. depth of hold, and 16 ft. 6 in. draft. When first commissioned, she carried a battery of twenty-four medium 24-pounders. In April, 1843, following her conversion into a storeship, her armament was reduced to six 32-pounder carronades. In November, 1844, she mounted four long 9's and four short 32-pounders. On her last cruise she had only the carronades on board. Her crew numbered 190 officers and men.

The *Lexington* was commissioned at New York, New York, on June 11, 1826, by Master Commander William B. Shubrick, for special service to the coast of Labrador in connection with the protection of American fisheries. On her return from this duty, she was sent to the West Indies to bring back the remains of Commodore Oliver H. Perry from Trinidad. Early in 1827 she was sent to the Mediterranean, where she cruised for almost three years under several commanders. Master Commandant B. W. Booth (April 28, 1827) took her out; the station being relieved on July 20, 1828, by Master Commandant S. L. Breese. Master

[1] Lieutenant Bazely's report to the British Admiralty.

Commandant James Ramage joined the ship at Port Mahon in August, but he kept her only six weeks and then turned her over to Master Commandant William M. Hunter (October 2, 1828).

From November, 1830, to June, 1831, the *Lexington* was laid up in ordinary at the Norfolk navy yard, Virginia. Her next cruise took her to the Brazil station, her commanders during this period being Master Commandant Silas M. Duncan (May 31, 1831) and Master Commandant Isaac McKeever (August 16, 1832). Then followed a visit to the Pacific coast, where our growing commerce necessitated the presence of an important naval force. On this cruise the ship was commanded by Commander John H. Clack (July 10, 1837).

On her return to the Atlantic seaboard, the *Lexington* was converted into a store vessel, and during the remainder of her career she served the various squadrons in this capacity. In April, 1843, she went to the Mediterranean, where she remained for several years, going afterwards to the Pacific Ocean. During the war with Mexico she operated on the coast of California, in command of Lieutenant Theodorus Bailey (June 2, 1846), transporting troops for the Army and assisting in the blockade. On January 12, 1848, she landed a party of men at San Blas, where the enemy's guns were brought off. Her last cruise was to the East Indies as storeship to Commodore Matthew C. Perry's famous expedition to Japan. She sailed from New York on June 18, 1853, under the command of Lieutenant John J. Glasson (May 25, 1853), and did not return to the United States until two years later. She was placed out of commission at New York on February 26, 1855, being subsequently disposed of by sale.

The third *Lexington* was a side-wheel gunboat of the fourth rate purchased by Commander John Rodgers at Cincinnati, Ohio, in June, 1861. Her cost was $20,666.66. She was altered for naval purposes by raising perpendicular oak bulwarks around her sides: these were five inches thick and proof against musketry fire. The boilers were dropped into the hold, and the steam pipes lowered as much as possible. She was originally a western river steamer, built at Pittsburgh, Pennsylvania, in 1860. Her characteristics were: burthen, 448 tons; length, 177 ft. 7 in.; breadth, 36 ft. 10 in.; depth of hold, 7 ft.; draft, 6 ft. Her engines were of the high pressure type, with a stroke of seven feet, and steam was furnished by three boilers. Her maximum speed was seven

knots. When first commissioned she carried a battery of four 8-inch smoothbores and two 32-pounders of 43 cwt. Later one of the 32-pounders was replaced by two 30-pounder Parrott rifles. In September, 1864, she rated two additional 8-inch guns.

Under Commander Roger N. Stembel (August, 1861), the *Lexington* was charged with the early operations and expeditions on western waters, particularly insofar as these reflected on the Union control of the Ohio, Cumberland, and Tennessee rivers. During the preparation of the main ironclad fleet, she joined the *Conestoga* and *Tyler* in intimidating the Confederate sympathizers by sudden incursions to threatened points. Thus the *Lexington* accompanied General Grant's movement against Paducah, Kentucky, in which there was no fighting, while Smithland, Kentucky, at the mouth of the Cumberland River, was seized a few days later. On September 4, 1861, she had a brush with the Confederate gunboat *Jackson* off Hickman, Kentucky, but "having very little powder on board and only half enough gun tackles for working the battery," Captain Stembel withdrew after having expended about twenty rounds.

Six days later a more serious affair took place. The *Lexington* and *Tyler* had taken up a position off Norfolk, Missouri, at the request of General Grant to cover an advance of the army in that direction. The operation was carried without incident, and the *Lexington* then turned her attention to some of the enemy's vessels, which were anchored under the bluff batteries at Lucas Bend. "We engaged them and soon silenced them," wrote Commander Stembel. One of the *Lexington's* 8-inch guns, charged with a fifteen-second fuse shell, was trained upon the *Jackson*, and "I had the satisfaction of seeing the shell explode in her starboard wheelhouse, careening her smokestack, and otherwise crippling her, when the rebel steamers retreated toward Columbus, the batteries on the bluffs alone preventing their capture."

On September 22, the *Lexington* was ordered to Owensboro, Kentucky, to guard the Ohio River. A fortnight later the active little vessel was back in the Mississippi, where she had another engagement with the enemy's batteries near Columbus, Kentucky. Then occurred the battle of Belmont, Missouri, where the *Lexington* and *Tyler* by their timely intervention saved General Grant's army on November 7. "The enemy planted their fresh artillery, supported by infantry, in a cornfield just above our

transports with the intention of sinking them when we started up the river, and of bagging the entire army," wrote an eyewitness, "but thanks to the gunboats *Tyler* and *Lexington* and their experienced gunners, they saved us from a terrible doom. They took up a position between us and the enemy and opened their guns upon them, letting slip a whole broadside at once. This movement was performed so quickly that the Confederates could not fire on us. Their guns were silenced as soon as they opened, or probably were dismounted. The first shot from the gunboats made a perfect lane through the enemy's ranks."

Under Lieutenant James W. Shirk, who was ordered to the *Lexington* on January 1, 1862, the vessel took part in some tentative movements up the Tennessee, and in the first week in February she joined in the attack upon Fort Henry. This works surrendered after an action of one hour and eight minutes. No sooner was the Confederate flag hauled down, than the *Lexington* and two other gunboats were sent up the river to destroy the railroad bridge connecting Bowling Green with Columbus. The movement was carried out so rapidly, that the Confederates were taken unawares. The trestle work was injured beyond repair, three steamers laden with military stores were burnt, and a large vessel, which the enemy were converting into a gunboat, was captured at Cerro Gordo, Tennessee.

After repairing at Carondelet, the *Lexington* again stood up the Tennessee as far as Pittsburg Landing, Tennessee, where the Confederates were actively engaged in erecting batteries. With the assistance of the *Tyler,* the enemy were easily dislodged on March 1, 1862, after which the two gunboats remained in the vicinity to frustrate any similar attempts. Thus it was, that while the main squadron was engrossed in the task of reducing Island No. 10 in the Mississippi River, the two insignificant and frail wooden gunboats were at hand to render valuable assistance to General Grant's army, when it was attacked by a superior force of the enemy in the following month. At daybreak on April 6, the Confederates launched a furious assault against the Union lines at Pittsburg Landing. General Grant's center was driven in towards the river, and the left wing was sorely pressed. The gunboats offered to open fire, to which General Hurlburt, who commanded on the left, replied that he was grateful for this offer of support as without reinforcements he would not be able to main-

tain his position for an hour longer. The Confederates had not anticipated the intervention of the gunboats, so that when the latter opened fire the assaulting columns were so close that their ranks were literally decimated, and the survivors driven off "in a perfect rout in the space of ten minutes."

The gunboats remained in the river until the latter part of May, when they were obliged to fall down on account of the low stage of the water. The *Lexington* stopped at Cairo only long enough to take on board two rifled 30-pounders, and then proceeded to join the main squadron before Fort Pillow. From there she was sent up the White River in company with the *Mound City, St. Louis,* and *Conestoga,* for the purpose of opening communications for the Union troops which were trying to reach the Mississippi through Missouri and Arkansas. An Indiana regiment accompanied the expedition. On June 17 the gunboats found their advance checked by two batteries, which the enemy had erected at St. Charles, Arkansas. A brisk engagement followed, in the course of which the *Mound City* was disabled by a shot through her steam drum. But the other vessels pressed on to the attack, while the troops successfully stormed the works from the land side. After occupying St. Charles, Lieutenant Shirk pushed sixty-three miles farther up the river to Crooked Point Cut-Off, where he was compelled to turn back by the falling of the water.

In the autumn the *Lexington* was detailed to escort army transports on the Mississippi and to protect them against the bands of guerrillas which infested the river banks. On the resumption of active operations in November, when the streams were rising from the autumnal rains, she was assigned to duty with Captain Walke's division of gunboats, with the mission to enter the Yazoo and clear the way for an advance of General McClernand's army against Vicksburg. The expedition got under way on December 12, the light-draft gunboats leading the column. The presence of torpedoes was soon discovered, but the work of clearing them was hazardous in the face of the numerous sharpshooters who were concealed behind the levees. Two ironclads were sent up to cover the operations, but one of them, the *Cairo,* was sunk by a torpedo which exploded under her bow. The work of removing the torpedoes continued for several weeks, every inch of ground being won under a constant fire of musketry. At Haynes' Bluff, further progress was stopped by the forts which lined the heights.

The ironclads shelled the enemy's position without success, and the troops assaulted it on December 29, but the attack failed entirely.

The continued rains now rendered the position of the army dangerous, and the movement was therefore abandoned. Instead the combined forces were diverted to the Arkansas River, where the *Lexington* participated in the capture of Fort Hindman on January 11, 1863. A few weeks later Lieutenant Shirk was ordered to patrol the Cumberland River "until the banks can be cleared of the heavy artillery represented as being there." The country between the Cumberland and Tennessee Rivers was infested by numerous bands of guerrillas and light irregular forces, and their depredations required the admiral to keep the streams constantly patrolled by a force of gunboats. The brushes between the *Lexington* and these bodies do not individually possess much importance, other than showing the continual and essential activities of the Navy in keeping open the Army's communications, aiding isolated garrisons, and checking the growth of guerrilla warfare.

On January 30, Lieutenant-Commander S. Ledyard Phelps was sent in the *Lexington* to look into the condition of affairs on the Cumberland River. Twenty miles above Clarksville he landed and burned a house used as a storehouse by the enemy. But on the way down, the vessel was fired upon by a battery of heavy guns and struck three times. Four days later, while convoying a fleet of transports with five light-drafts below Dover, the *Lexington* was met by a steamer bearing a message from the commanding officer of that post to the effect that his men were being attacked by an overwhelming force. Hastening to the scene of battle with his gunboats, Lieutenant-Commander Le Roy Fitch (February, 1863) arrived just as the Confederates were completing their encircling movement. The Union garrison was in extremis, having expended all their ammunition. The appearance of the *Lexington* and her consorts took the enemy wholly by surprise, and after the second broadside they fled in confusion, leaving one hundred and forty of their dead on the field.

Having returned to the mouth of the Cumberland to coal, Lieutenant-Commander Fitch received a telegram early in April that a convoy had been attacked at Palmyra, thirty miles above Dover, and the gunboat *St. Clair* disabled. He at once got under way with

several other vessels, and on reaching Palmyra the town was laid in ashes, in retaliation for the firing on unarmed vessels and harboring guerrillas. A raid was also made against a body of the enemy further up stream, but they had notice of his approach, and made good their escape.

On June 7 another Union garrison was saved from annihilation by the timely arrival of the *Lexington* and *Choctaw*. A large body of Confederates made an attack against Milliken's Bend, Louisiana, which was guarded by two colored regiments and a part of the Twenty-ninth Iowa. "The blacks met the onset manfully," wrote Rear Admiral Porter in his official report, "and a company of the Iowa regiment stood at their post until they were slaughtered to a man, killing an equal number of rebels. The fight was desperate, and our men, overpowered, had to retreat behind the bank, near the water's edge, followed closely by the rebels. There the gunboats opened on the rebels with shell, grape, and canister, and they fled in wild confusion, not knowing the gunboats were there or expecting such a reception."

In the spring of 1864 the *Lexington,* under Lieutenant George M. Bache (June 15, 1863), took part in the famous Red River Expedition. The fleet, consisting of twenty ironclads and gunboats, the transports following, started up the morning of March 12. The enemy were driven from Simsport and Fort de Russy, the latter being again captured with its guns and a small garrison. Alexandria was captured by the combined forces on April 15, when commenced the move towards Shreveport, Louisiana, the principal depot of the Confederates west of the Mississippi, and three hundred and forty miles farther up the river. Only a part of the naval force could proceed beyond Alexandria, but the assistance of the gunboats was so essential to success that the *Lexington* and ten other vessels were hauled over the falls. Grand Encore was reached and occupied. There were indications of the usual rise in the river, and everything promised success. But at Springfield Landing the gunboats were greeted with the news that the army had met with a reverse at Pleasant Hill and was falling back. This obliged the vessels to drop down the river, but on their return they were attacked at every assailable point by the Confederates, who were flushed with victory. On April 12 they came near capturing six transports at Blair's Plantation, "but were handsomely received by the *Osage* and *Lexington* in the old

style," to quote the admiral's own words, and driven off with heavy loss.

On reaching Grand Encore, it was found that the river, which ordinarily remains high till June, had so fallen that the gunboats could not repass the rapids above Alexandria. There was little prospect of getting the vessels out, and destruction seemed inevitable. But desperate as the case seemed, relief came. Lieutenant Colonel Joseph Bailey, acting engineer of the Nineteenth Army Corps, devised a plan for a series of dams across the rocks at the falls, thus supplying sufficient depth of water for the passage. The dams were built, and, the water rising, three gunboats were ordered through on May 9. The *Lexington*, having steam up, was sent down first. She steered straight for the opening, where the furious rushing of the waters seemed to threaten her with destruction. She entered the gap with a full head of steam, pitched down the roaring torrent, made two or three heavy rolls, hung for a moment on the rocks below, and then, sweeping into deep water, rounded to at the bank, safe.

After this the *Lexington* returned to the Mississippi, where during the remainder of the war she was employed chiefly in patrol and convoy duty. On June 22, 1864, she drove off a Confederate attack against White River Station, Arkansas, after which she took up her station at Skipwith's Landing, Mississippi. Acting Master William Neil commanded the vessel from October 25 to November 18, 1864, being succeeded by Acting Volunteer Lieutenant William Flye, who kept her until she was placed out of commission at Mound City, Illinois, on June 2, 1865. The *Lexington* was later sold (August 17, 1865) at public auction to Thomas Scott & Woodburn for $6,000.

The fourth vessel of the Navy to bear the name *Lexington* was a battle cruiser of the first line authorized by the Naval Appropriation Act of August 29, 1916. She was to be a steel armored ship of 43,500 tons, with the following dimensions: length, 850 ft.; breadth, 101 ft. 8 in.; draft, 31 ft. Her propelling machinery was to consist of quadruple-screw Westinghouse turbines of 180,000 horsepower, with sixteen White-Forster oil-burning boilers. Her estimated speed was 33 knots. She was designed to carry a battery of eight 16-inch rifles mounted in turrets, with a secondary armament of sixteen 6-inch rifles and four 3-inch anti-aircraft guns. Her torpedo armament was to

include eight 21-inch torpedo tubes. The contract for her construction with the Newport News Ship Building Company was signed on May 24, 1917, but before her keel could be laid, the Navy Department ordered her name changed to *Ranger* (December 10, 1917).

The fifth *Lexington* is a quadruple screw aircraft carrier of 35,000 tons, being built by the Fore River Shipbuilding Company at Quincy, Massachusetts, under the terms of the Acts of August 29, 1916, and July 1, 1922. She was originally designed as a battle cruiser, but following the signing of the treaty limiting naval armaments her plans were modified, and she was transformed into an aircraft carrier. Her principal characteristics are: length, 850 ft.; breadth, 101 ft. 8 in.; draft, 31 ft. She has General Electric turbines of 33,000 horsepower, with electric drive, for which steam is supplied by sixteen Yarrow boilers. Her estimated speed is 22 knots. The armament consists of sixteen 6-inch rifles, mounted on twin mounts. The vessel is fitted with a hangar of sufficient size to hold a fleet of airplanes, and several machine shops for the repair of disabled machines.

The *Lexington* was borne on the Navy register for several years as the *Constitution*, but her name was changed on December 10, 1917, to *Lexington* by order of the Navy Department.

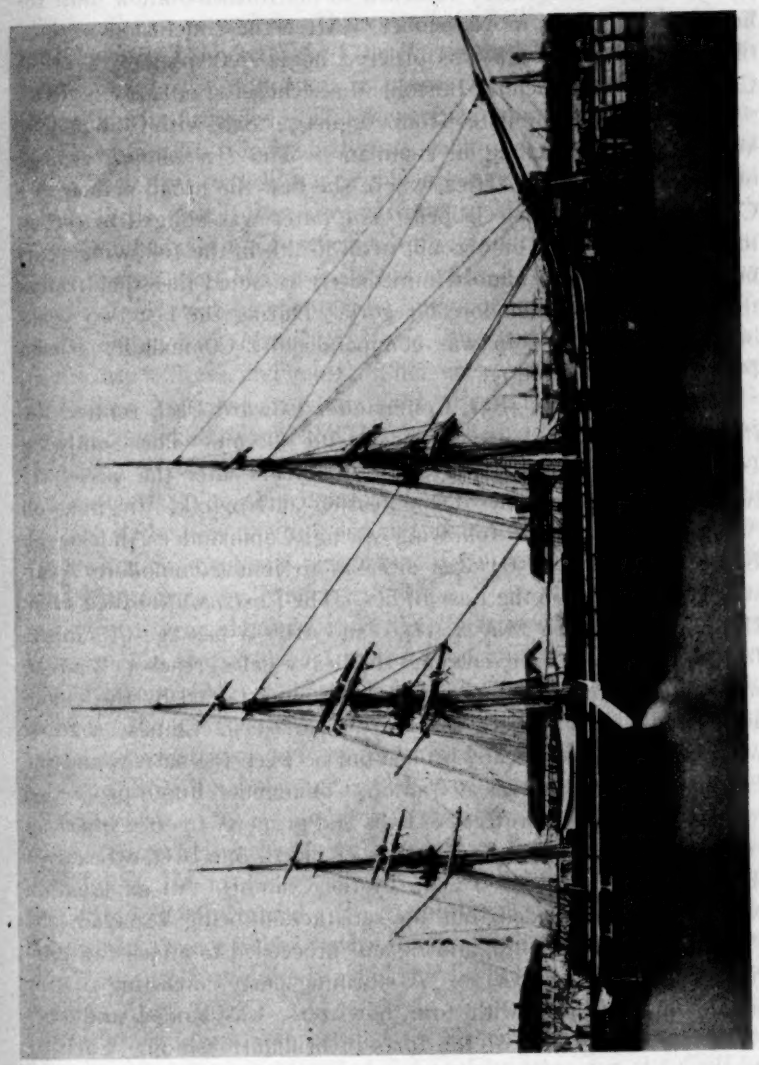
"Portsmouth"

The first *Portsmouth* was a 24-gun ship built by the government during the war with France. Her construction was authorized by the Act of June 30, 1798, and she was completed in the same year at a cost of $59,560.00. Her burthen was 593 tons and she was manned by a crew of 220 men.

The *Portsmouth* went to sea in December, 1798, in command of Captain Daniel McNeill, under orders to cruise in the West Indies as part of the squadron of Commodore Barry. In the following year, she was stationed off the coast of the Dutch colony of Surinam, occasionally convoying merchantmen on their way to or from the United States. Following the conclusion of peace with the French Government, she was sent over on special service to bring home the American envoys. She was sold out of the service in 1801, under the terms of the naval peace establishment, $34,366 being realized from her sale.

The second *Portsmouth* was a 20-gun sloop of war built at the Portsmouth navy yard, New Hampshire, where she was launched on October 23, 1843. Her cost was $170,586. The hull was of live oak, with the following dimensions: burthen, 1,022 tons; displacement, 1,125 tons; length, 153 ft.; breadth, 38 ft. 1 in.; depth of hold, 16 ft. 9 in.; draft, 16 ft. 6 in. The battery underwent numerous changes. At first it consisted of four 8-inch shell guns and eighteen long 32-pounders, but in October, 1852, two additional shell guns were mounted, while the broadside guns were reduced to sixteen. Four years later she carried sixteen 8-inch guns. On the outbreak of the Civil War, a 12-pounder howitzer was added, and soon after she was also given a 20-pounder Parrott rifle. On July 1, 1863, two 8-inch guns of 55 cwt. were added. In the following year, another gun, a 100-pounder Parrott rifle, was put on board, but after a few months the Navy Department ordered the battery reduced until there remained only one rifled 20-pounder and sixteen 8-inch guns. In 1872 the ordnance records credit her with having on board four 8-inch guns of 65 cwt. and one 30-pounder Parrott rifle. In June, 1874, she carried twelve 8-inch guns, two 20-pounder Parrott rifles, two 24-pounder howitzers and two other pieces of lighter caliber. Two 8-inch guns and two howitzers were removed in August, 1875, but four years later one of the former was again mounted in the ship. In February, 1884, there were one 8-inch gun and one 60-pounder breech-loading rifle. In May, 1889, she carried eleven 8-inch guns, one 60-pounder rifle, two 20-pounders, and two other guns. Before 1861 she usually had a crew of 210 men, but during the Civil War the muster rolls give her only 161 men.

The *Portsmouth* was placed in commission at Portsmouth, New Hampshire, on November 10, 1844, by Commander John B. Montgomery, who proceeded in her to the Pacific Ocean. There she joined Commodore Sloat's squadron, which was engaged in watching the movements of numerous British cruisers concentrated off the coast of Mexico, yet ready in the event of hostilities with the neighboring republic to act with promptness and vigor. Events moved quickly, and on July 7, 1846, the commodore sent a landing party ashore to hoist the American flag over the city of Monterey. On the following day, Commander Montgomery took possession of the shores of San Francisco Bay. A few months later, the *Portsmouth* accompanied the flagship to the Gulf of California,



U. S. S. "PORTSMOUTH"

where she took up a position off the town of Guaymas. The American colors were raised over San José on March 30, 1847, early in April San Lucas and La Paz were occupied, after which Commander Montgomery returned to his former station until relieved by the *Dale* in November. After the conclusion of hostilities, the *Portsmouth* was ordered home, returning by way of Cape Horn and reaching Boston, Massachusetts, on May 9, 1848.

A new commission dates from August 7, 1848, with Commander William M. Armstrong in command. The *Portsmouth* cruised off the west coast of Africa, where she flew the broad pennant of Commodore Benjamin Cooper. The latter was obliged to return to the United States on account of ill health in the following year, but the *Portsmouth* almost immediately rejoined the squadron as the flagship of Commodore Gregory. During the last two years of the cruise, the ship was commanded by Commander Elisha Peck (October 6, 1849).

On November 20, 1851, Commander Edward Peck refitted the *Portsmouth* for a cruise to the Pacific Ocean. The Sandwich Islands were visited in 1853, and two years later the vessel returned home, going out of commission at Norfolk, Virginia, on April 9, 1855. In the following spring, Commander Andrew H. Foote (April 22, 1856) was directed to join Commodore Armstrong's squadron in the East Indies. The *Portsmouth* sailed from Hampton Roads on May 4, 1856, and after a passage of ninety-four days, in which she encountered heavy gales, reached Batavia, where the officers were most hospitably entertained by the Dutch authorities. From there the ship repaired to Chinese waters. where troubles had already broken out between the natives and the English. On his arrival at Canton, Commander Foote proceeded to take measures to protect the lives and property of the American residents of that city. While thus engaged, one of the boats of the *Portsmouth* was fired upon by the Chinese. An explanation was at once demanded, but no satisfaction being received, the *Portsmouth, San Jacinto,* and *Levant* proceeded to attack the Barrier Forts on November 20. A storming party consisting of 287 sailors and marines, with four howitzers, was landed and succeeded in taking four of the forts in brilliant fashion. Each of the works captured mounted from forty to fifty guns. Soon after the beginning of the action, a portion of the Chinese Army at Canton, variously estimated from four to fifteen thousand, ad-

vanced to the relief of the forts, but, after being twice repulsed by the marines, they returned whence they had come. *The Portsmouth* was under fire for three days, and received eighteen shot in her hull and rigging. Two members of her landing party were killed and five wounded. "I cannot help believing that the heavy and prolonged cannonading of the *Portsmouth*," wrote Commander Foote, "was most important in preparing the way for the operations which succeeded. The powerful battery of this ship, consisting of sixteen 8-inch shell guns, each of 63 cwt., so paralyzed the nearest fort, which was within a range of four hundred and eighty yards, that it was never afterward able to do injury which it might otherwise have inflicted." In January, 1857, Commander Foote visited the Chinese ports opened to American commerce by treaty, after which he ran over to Singapore to look into the affair of the Dutch bark *Henrietta Maria*, that had been abandoned at sea by her officers and most of her crew, and brought into that port by an American merchant ship. From there the *Portsmouth* went to Bangkok, where the ship was visited by one of the kings of Siam, "a courtesy never before extended to a man-of-war of any nation." The ship continued to cruise on the station until the end of the year, visiting various ports, and then she returned to the United States, being placed out of commission at Portsmouth, New Hampshire, on June 21, 1858.

Almost a year elapsed before the *Portsmouth* was refitted, and then she was sent to the African station in charge of Commander John Colhoun (May 4, 1859). A large squadron was maintained there by the government, with a view to putting a stop to the African slave trade, and the American cruisers were assisted in this by a British naval force, which was under orders to cooperate in every way. On September 21, 1859, the *Portsmouth* captured the American slaver *Emily* off St. Paul de Loando, and in the following year she made two more captures, both of which were sent into port and condemned. On the outbreak of the Civil War, the Navy Department issued orders for the recall of the ship, but these were some time reaching her and she did not leave the station until early in August, 1861.

The *Portsmouth* was refitted on December 1 by Commander Samuel Swartwout and sailed a fortnight later for the Gulf of Mexico, where she was assigned a blockading station off the coast

of Texas. On February 1, 1862, she intercepted the English steamer *Labuan* off the mouth of the Rio Grande, which resulted in the exchange of considerable correspondence. About the middle of April, she was relieved by the *Montgomery,* which brought orders for her to join Flag Officer Farragut's squadron in the Mississippi River. During the passage of Forts Jackson and St. Philip by the fleet, on the morning of April 24, the *Portsmouth* was towed within range of the enemy's works for the purpose of enfilading them. But soon after she came to anchor, the spring was shot away and the ship swung around, so that none of the guns could be brought to bear upon Fort Jackson. The *Portsmouth* soon became the target for the enemy's guns, their shot and shell dropping "with great rapidity all around and close to the ship," so that it was found necessary to slip the cable and drop downstream out of range.

After the surrender of New Orleans, Louisiana, the admiral prepared to push on toward Baton Rouge, Natchez, and Vicksburg. The *Portsmouth* was directed to anchor off the city for the protection of the troops left to garrison it, and this appears to have been her station until the end of the war. Commander Lewis C. Sartori joined the ship on August 4, 1863 and kept her two years, being relieved on April 22, 1865 by Lieutenant Commander Samuel R. Franklin. The ship left her anchorage in the Mississippi River on August 6, 1865 under orders to go out of commission at New York, New York.

In 1866 the ship was employed on ordnance duty, also being placed at the disposal of the Health Commissioners for quarantine purposes in New York harbor, under the terms of the Act of Congress of March 24, 1866. She was refitted on June 3, 1867, by Commander Joseph S. Skerrett for special service, and two years later she made another cruise under Commander Alexander A. Semmes (January 1, 1869), which lasted twenty-three months. Then followed a brief commission on the South Atlantic Station, the ship being in charge of Captain Charles H. B. Caldwell (April 8, 1872) and Captain James W. A. Nicholson (June 28, 1872). Her last cruise took her to the Pacific Ocean, which was the scene of her first exploits. She sailed from New York on December 23, 1872, under Commander Joseph S. Skerrett (August 23, 1872), and after three years of surveying in the vicinity of the

Hawaiian Islands, she was placed out of commission at Mare Island, California, August 7, 1876.[1]

From 1879 to 1895 the *Portsmouth* was used as a training ship for naval apprentices, following which she was loaned to the naval militia of the state of New Jersey. She was returned on March 4, 1911, to the Navy Department, which loaned her to the Marine Hospital Service. She was stricken from the Navy register on April 17, 1915.

[1] During the last ten months she was commanded by Commander Silas Casey.

THE UNITED STATES NAVAL OBSERVATORY

Its Function With Special Reference to "Time"

By Captain Edwin T. Pollock, U. S. Navy, *Superintendent*

VERY little seems to be known about the Naval Observatory by the public and even by the Navy itself, for whose service it was established.

The naval vessels requisition navigational and surveying instruments and get them without delay from the $2,000,000 stock on hand; they send in those instruments for repairs, which are made carefully and the instruments returned promptly; they use the improved gyro-compass without thinking how it was developed; they receive the *American Ephemeris* and *Nautical Almanac* annually without asking for it; they get the "time" without any special effort. As to how all the above is accomplished, most people are ignorant.

Should the Naval Observatory or any of its departments cease to function, what it means to the Navy and to the country in general would very soon be realized by those who think of the staff of the observatory as merely "star-gazers" who consider themselves above mundane things. As a matter of fact, the entire country, and the Navy and merchant marine in particular, is indebted to the Naval Observatory for its painstaking work.

To explain why the Naval Observatory determines the "time" for the United States, and sends out the time signals, it is desirable to go back to days when the needs of the American Navy led its officers to be the first to see the need for "time." With such vision they started its determination.

Similarly, the need for an American *Nautical Almanac* by the American Navy led a naval officer to establish the American Nautical Almanac Office. Both are correlated, and the manner of their starting will be dwelt with later. Both are essential to the national defense, and that is why they are under the Navy Department, the department of the government most concerned.

Over ninety-two years ago, Lieutenant Charles Wilkes, U. S. Navy, later of South Sea exploring fame, erected, at his own ex-

pense, near the Capitol, a small building, sixteen feet square, and equipped it with a 3¾-inch transit instrument borrowed from the Coast Survey. This was some twenty-two years after the first endeavors were made to have an astronomical observatory established in Washington, D. C., for the benefit of a "navigating and commercial people." The building and transit instrument have long since disappeared, but that observatory was the beginning of the present Naval Observatory on Georgetown Heights, with its fine equipment of instruments and its fifty-four buildings on grounds comprising about seventy-two acres. It has established a high reputation for its products, especially for the accuracy of its time signals, which are used throughout North America by scientists, surveyors, railroads, jewelers, and by "those who go down to the sea in ships," as well as by almost every one who has a time piece. Even those prospecting for oil field deposits use them and want the errors to the .001 of a second as their gravity determinations.

That first little observatory, built in 1834, was a part of the "depot of charts and instruments" established by the Navy Department in 1830, to look out for the charts and instruments used by our naval vessels. Before that time each ship had to get its outfit of sextants, chronometers, charts, etc., as best it could, procuring them when and where possible, and without assurance of their accuracy. When the cruise was ended, the outfit, or what was left of it, was dumped into a store house at a navy yard, where the instruments deteriorated, and the rats and mice played havoc with the charts and books.

The depot became the receiving and distributing point with results good to a certain extent, but it was soon evident that without proper means for rating chronometers, it was not all it should be. "Time" was a necessity.

Lieutenant L. M. Goldsborough, U. S. Navy, the first officer-in-charge, had been succeeded by Lieutenant Wilkes, who built his little observatory for taking star sights to determine the exact time used in rating the chronometers in his care. Thus the need of the Navy for "time" led to its determination by the Navy. Without exact time a navigator would be literally "at sea," and military operations depend on a "zero hour," whether on sea or land.

The depot was also the beginning of the present Hydrographic Office, with its complete equipment for printing charts and sailing directions for all seas; its system for collecting and distributing information to shipmasters by means of daily, weekly, and monthly bulletins; and monthly pilot charts of the seven seas, which are so essential to the masters of merchant vessels, as well as to the Navy.

The activities of the depot, which soon ceased to be known as such, were many, for, besides looking out for charts and instruments, it had an astronomical observatory, a hydrographic office, a meteorological observatory, and, by 1866, a magnetic observatory. In that year a resolution of the United States Senate required the superintendent to furnish "the summit-levels and distances by survey of the various proposed lines for interoceanic canals and railroads between the waters of the Atlantic and Pacific Oceans, as well as their relative merits as practicable lines for the construction of a ship canal and especially as relates to Honduras, Tehuantepec, Nicaragua, Panama, and Atrato lines."

These activities were too diverse for a single institution, and Congress that same year established the United States Hydrographic Office, which took over the hydrographic work the Observatory had started.

As this article deals primarily with the Naval Observatory, the Hydrographic Office will be mentioned only incidentally, but the two institutions continue to cooperate to the fullest extent, as the work of both is primarily for the Navy and the sea-faring man, as is also the work of the Nautical Almanac Office. The last, established in 1849 by Lieutenant Charles H. Davis, 1st, U. S. Navy, was located at Cambridge, Massachusetts, as a separate office. It was moved to Washington, D. C., in 1866, and in 1894 was made a part of the Naval Observatory, occupying a part of the main building. The first volume of the *American Ephemeris* and *Nautical Almanac*, printed in 1852 for the year 1855, marked the beginning of the era in which the United States ceased to be dependent on foreign publications for its astronomical data.

Lieutenant J. M. Gillis, U. S. Navy, succeeded Lieutenant Wilkes in charge of the depot in 1837, and remained in charge until 1842. He was then designated by the Secretary of the Navy to prepare plans for, and to build and equip an observatory (now

the Naval Medical Museum), authorized by Congress. That work was successfully completed in 1845, and when its completion was reported to the Secretary of the Navy, he expressed what has ever since been the aim of the Naval Observatory—"regarding this only as a naval observatory it is of the utmost importance that we give the service the greatest possible benefit from it."

Lieutenant M. F. Maury, U. S. Navy, succeeded Gilliss in 1842, and, on completion of the observatory, remained in charge of it until he went south in 1861. He devoted more of his time to the development of hydrographical and meteorological work than had Gilliss, who was above all an astronomer.

So while Gilliss completed what Wilkes started—a naval observatory—Maury may well be considered the founder of the present Hydrographic Office. His sailing, wind, and current charts brought him more recognition from foreign governments than has ever been given any other American, if not any man of any nationality, for such work.

The Present Naval Observatory.—The gradual growth of the Naval Observatory and its usefulness resulted in Congress appropriating funds for the purchase of a new site in 1880 (it was a wilderness then), and in the erection of the necessary buildings which were formally occupied in 1893.

Activities.—At the present time its activities are:

a) The continuous maintenance of observations of the heavenly bodies for improving the tables of the planets and their satellites, of the moon, and of the stars, and for determining the fundamental constants used in preparing the *American Ephemeris* and *Nautical Almanac*. At the same time the department of astronomical observations furnishes the observations for determining the time.

b) The furnishing and transmission of daily time signals, both by radio and by telegraph.

c) The computing, preparing, and publishing of the *American Ephemeris* and *Nautical Almanac*, and the *American Nautical Almanac*.

d) The development, supply, upkeep, repair, and inspection of all navigational and surveying instruments used by naval vessels, whether surface, submarine, or aircraft. Some instruments are also furnished coast guard and shipping board vessels.

Organization.—The organization of the Naval Observatory consists of the offices of the superintendent and assistant superintendent; the offices of the astronomical council and executive committee; the library; the administrative section; the astronomical branch, which comprises the department of astronomical observations with its five divisions, and the department of the *Nautical Almanac,* and the nautical branch, which consists of the department of material with its six divisions.

The astronomical council consists of the superintendent, the assistant superintendent, the director of the *Nautical Almanac,* and the heads of the five astronomical divisions, all but the first two being experienced astronomers.

The department of material comprises six divisions: the magnetic compass, the gyro-compass, the air navigation and aerological instrument, the nautical instrument and time service, the supply, and the inspection divisions. The heads of these are line officers of the Navy.

Details concerning the duties of all divisions will not be discussed, but all the work of the Observatory is of practical utility, the only research work being in the primary work of the astronomical branch, astronomy of position. Two of the astronomical transits are also used for determining the "time." As sun spots are connected with electrical storms in the sun, and as they affect radio, cable, and telegraph communication, daily photographs of the sun are taken, and reports sent to cable and telegraph companies so they can guard against induced currents damaging their lines. Total eclipses of the sun are observed whenever possible, as the observations help in improving the tables in the *Almanac.*

The magnetic compass division handles the details relating to all magnetic compasses, to maneuvering and navigational features of ships, and conducts a compass school for the instruction of officers.

The gyro-compass division has charge of the design and procurement of gyro-compasses and their installation on vessels of the Navy. It coordinates its work with the Bureau of Ordnance, as the accuracy of fire-control systems depends on the accuracy of the gyro. It has charge of the inspection as well as of the development of the gyro.

The division of nautical instruments and time service has charge of the "time" and time signals. It has charge of the purchase,

inspection, and issue of all navigational and surveying instruments for the Navy. It conducts a nautical instrument repair shop at the Observatory. It gives consideration to and tests new instruments and devices for use in navigating and maneuvering vessels.

The air navigation and aerological instrument division does work in regard to its instruments similar to that done by the nautical instrument division in regard to its instruments, but the former works in conjunction with the Bureau of Aeronautics.

Determination and Distribution of "Time".—Ever since the establishment of the depot of charts and instruments one of the principal features of that depot and the succeeding institutions has been the determination of "time".

A time ball was erected on the first Naval Observatory for the benefit of others. In 1865 the time signals were first sent out by telegraph from the time room. In 1904 they were first sent out by a naval radio station, and early in 1905 the regular naval radio time signal was inaugurated, leading by two years every other nation in that respect, thanks to the Navy.

In determining the "time", observations are made every clear night, either with the six-inch transit circle, or a Prin transit, or with both, sometimes by one man using first one and then the other, and sometimes by two men. The differences between the observations, due partly to the difference between the instruments, and partly to the personal equations of the observers, is remarkably small.

The stars selected are those which cross the meridian near the zenith at Washington, and whose positions are well known. The transit instruments are mounted so that they may be rotated from north to south, but not from east to west. As the stars pass through the field of view with the rotation of the earth, the observer operates a micrometer apparatus which causes an interruption in an electric circuit each time the stars cross the spider lines. The interruptions are recorded by a chronograph on the same sheet with the records of the standard clock beats.

By making measurements on the sheet, the exact times, according to the clock, that the stars cross the center of the field of view may be determined to the hundredth of a second for each observation, and the averages are reckoned to the thousandth of a second.

Although the telescopes are rigidly mounted, they can never be made to rotate exactly in the plane of the meridian. Consequently

it is necessary to apply certain small corrections to allow for these instrumental errors.

The clock system is one of the best that has been devised. Three Riefler clocks, regulated to keep sidereal or star time, are used as standard. The pendulums of these clocks are of *invar* and do not change appreciably in length with variation of temperature. They also have a rather unusual form of escapement in which nothing touches the pendulum rod directly, the impulse being imparted through the suspension springs. These clocks generally tend to run faster during the first year after cleaning, their daily rates being apt to increase as much as a hundredth of a second. After about a year they run at a more constant rate. It must be remembered that the actual rate of a clock is not important so long as it is steady, or so long as it changes slowly and regularly enough to be checked up by astronomical observations. Sudden changes of rate impair the usefulness of any time piece. The rates of these clocks can be predicted to within about one hundredth of a second per day.

These Rieflers are mounted in an underground vault, each on its own stone pier set so far in the earth as to be free from all ordinary earth vibrations. Each is in a sealed glass case in which the air pressure is maintained at approximately 650 mm., the pressure being adjusted so as to give the clock a slightly losing rate, while the temperature is kept constant at 84° F. The temperatures in the vault and in the clock cases are automatically recorded in the main office building, and a bell rings when any sudden variation occurs.

Since the clocks run better if undisturbed, the cases are never opened nor the clocks reset, nor disturbed in any way unless they show signs of needing repairs. Since their errors and rates are known from astronomical observations, they furnish the true time with great accuracy.

For sending out the time signals special transmitting clocks are used. They are also mounted on piers set into the earth and in the room known as the time room. While these clocks are of high accuracy, they are compared with the standards before each signal, half an hour being allowed for making the comparisons and the adjustments so they will indicate the correct time. These adjustments are made by means of a magnetic device on their pendulums. They have electric break-circuit apparatus for emitting the signals. In making the comparisons it is necessary to take into

consideration the continually changing difference between mean solar time and sidereal time and also the error of the standard clock.

The signals are then sent automatically. From 11:55 A.M. to 12:00 noon, and from 9:55 to 10:00 P.M., Eastern Standard Time, dashes are sent out on each second, except that the twenty-ninth second of each minute, the fifty-fifth to fifty-ninth seconds inclusive of the first four minutes, and the fiftieth to fifty-ninth seconds inclusive of the last minute are omitted. In all cases the beginning of the dash denotes the beginning of the second, the end of the dash having no significance.

Telegraph lines lead from the Naval Observatory switch-board to the naval radio stations, so that the operation of the latter is entirely automatic, being controlled by a small steel break-circuit wheel in the sending clock. During the transmission of the signal a chronograph record is made in the time room, showing on the same scale and sheet of paper the ticks of the standard clock used, the ticks of the transmitting clock, and the ticks as received back by radio from the sending station being listened to. The elapsed time between sending out the time signal and its return via Arlington Radio Station is about .07 of a second, that line and the one to Annapolis being the only ones without a relay. Relays are necessary in the lines to the other stations in the United States, of which there are eight, each using a different wave length. The signal from San Diego goes through thirteen relays, and consequently has a lag of about one-half second. The chronometer and time station at Mare Island also sends out the signals by radio and by telegraph. Time signals are also sent from the naval radio stations at Balboa, Pearl Harbor, and Cavite, but none of them have the accuracy of the Arlington and Annapolis signals. The actual lag of the last two is measured regularly and tabulated, but the lags of the other stations are measured only occasionally.

A number of private radio stations also broadcast the time signals by automatic re-radiation, while telegraph and telephone lines carry the signals to most of the cities and towns in the United States.

Anyone who wishes to do so can run his own line to the Naval Observatory and get the signals. The Western Union clocks giving "Naval Observatory Time, Hourly by the Western Union" furnish general service at slight cost. These signals are not, however, scientifically accurate.

What would happen to the railroad service in the United States if the time service were discontinued or even interrupted? What would the mariner do without the means for determining his chronometer error upon which his position at sea depends? During the World War how much depended on the destroyer escort meeting the troop transports at the rendezvous at the pre-arranged time? Never once did they fail. They got the "time" and, with the *Nautical Almanac* and their sights of celestial bodies, determined their positions, and then made contact.

Foreign Time Signals.—The Naval Observatory receives and records foreign time signals, thus furnishing a basis for international time comparisons. Likewise the Naval Observatory time signals are recorded for the same purpose in foreign countries as far away as Australia and New Zealand.

There are very slight differences between the "times" as determined in different countries, and the reasons for these differences are being investigated. The solution will probably be ranked as the most advanced work in horological science.

Need for Accuracy.—The time signal, with its error seldom exceeding .03 sec., serves for ordinary purposes of commerce and navigation; but for scientists in their various quests for knowledge, such as the determination of gravity, the measurement of minute angles to the .001 of a second, and the measurement of vast distances which can only be expressed in "light years", the accuracy of "time" is everything. So the Naval Observatory, in its aim to benefit, calculates the error to the thousandth part of a second, as well as the time it takes for the signal to go through the transmitting instruments, i.e., the lag of each signal, and the tabulation is sent each month to those desiring it, whether they are in the United States, Europe, South Africa, or Australasia.

Longitude Determinations.—In early longitude determinations, chronometers were used, but they were cumbersome, and at times inaccurate; then telegraph and cable lines were used where possible, but radio has supplanted all other methods for transmitting time signals.

The Naval Observatory time signals have been used for longitude work for some years. A Swiss commission appointed to determine a disputed boundary in South America used them until their work, taking over two years, was completed. In 1924 three different departments of the Canadian Government used them in

determining positions in their great northwest country. One previously accepted position was found to be fifteen miles out.

In 1925, special signals were sent from the San Diego station, using a break-circuit chronometer. The U. S. Coast and Geodetic Survey used them in the western Aleutian Islands, and the Canadian Government used them from north of the Lake of the Woods to north of the Great Slave Lake. (The Annapolis signals were too faint at these distances.) The Naval Observatory recorded the signals and determined the errors. The apparatus of the surveyor was light and was carried on his back. He used his transit to "shoot" a star. With his own time piece, his radio receiver to receive the time signal, and his nautical almanac, he had all that was necessary to determine his position approximately. When he returned to civilization and got the correction for the time signals he soon worked out his exact positions. Without the time signals such determinations of position would not have been possible.

In 1913-14 in conjunction with the French the difference in longitude betwen Paris and Washington, a distance of about 3,830 miles, was determined by radio, using the Arlington and Eiffel Tower stations. The greatest distance in previous radio determination of longitude was about 860 miles. The results of the two sets of observers who interchanged instruments, places, and stations agreed to within .002 of a second, making them of the greatest accuracy.

Plans are under way for determining this year a longitude net around the world, using the radio stations at Annapolis, Pearl Harbor, and Bordeaux, and occupying observing stations at San Diego, Shanghai (or Saigon), and Algiers, while secondary stations for observing will be occupied all over the world. The purpose of this "round-the-world" work is to obtain fundamental points for the adjustment of charts covering the entire globe. The final results may show many errors in the present accepted positions of places, islands, etc., and subsequent observations may show movements of the earth's crust which are suspected. No such work has been possible before this.

It will undoubtedly take careful calculations, after the differences in longitude have been determined, to "close" the fundamental polygons, and then the secondary polygons, with the results of the observations at the many observing stations. The

results will, however, be of great value to the seaman, the geographer, and to various scientists.

Surveying.—Besides navigational instruments, all surveying instruments used by surveying parties of the Hydrographic Office and surveying ships are bought, inspected, issued, and repaired by the Naval Observatory. The astronomical department also cooperates. Before sending out an expedition, the Hydrographic Office sends the officers to the Naval Observatory for instruction in setting up its astronomical instruments, such as transits, and in using them under the eye of an astronomer. They are given instruction in selecting the stars most suitable for observation at the prospective location, and in working out sights with utmost care; for the safety of a vessel depends on the accuracy of the survey.

Nautical Instrument Repair Shop.—Fifteen skilled instrument-makers are employed, and during the last fiscal year over 4,770 instruments were repaired, quality of work being the first requisite. The instruments included altimeters, azimuth circles, barometers (mercurial and aneroid), binoculars, chronometers, clocks, compasses, three-arm protractors, sextants, spyglasses, stadimeters, transits, universal drafting machines, watches, etc. In re-graduating sextant limbs and transits an automatic circular dividing engine of high grade is used.

Summary.—From the beginning the Observatory has been a Naval Observatory, primarily for the United States Navy and merchant marine; and its aim is to benefit not only the service, but the world at large, notwithstanding the fact that it is an integral part of the national defense. Naval radio stations, time service, *Nautical Almanac,* survey of the seas: all are vital to national defense. At present the Navy Department, under which they all operate, coordinates these various activities. Such administration is undoubtedly more efficient than would be possible if responsibility for them were divided. It is evident that no change should be made that might in any way interfere with the Naval Observatory's long established policy of rendering the best possible service to everyone.

THE THRESHOLD OF A NEW ERA IN INTERNATIONAL LAW[1]

By Lieutenant Commander Lucius C. Dunn, U. S. Navy

OUT OF the vague haze of controversy and circumlocutionary ramifications incident to the many conferences, plenary sessions, debates, congresses, conventions, and what not, which have taken place on the four corners of the earth during this post-war age, one significant fact emerges clear as crystal, and that is that the best and most advanced thought in all civilized countries is definitely concentrated in an attempt at evolving some plan by which wars may be averted.

Call them what you will, leagues to enforce peace, outlawry of war, compulsory arbitration arrangements, international courts of justice, Hague tribunals, and so on down through the long category of movements proposed for preserving the peace of the world, they all serve very potently to indicate to thinking people the possibility that a state of mind may gradually be developing among the masses in the interest of the cause—a general moral awakening against the crime of aggressive war.

And, whether or not we approve or subscribe to those various plans and movements, or can detect any meritorious or constructive features in them, the fact remains that the outstanding highlight of the times—the history of the moment, so to speak—is that civilized humanity, it matters not what the race or creed, is groping for some means of preventing armed conflict between nations.

Moreover, in sharp contrast with the preachments of the pitiable pacifist advocates—those emotional theorists—and their peace at any price doctrines which, unfortunately, are present in some degree in every country, it should in justice be said that the best minds and leaders of the larger movement for preserving the peace of the world duly recognize the supreme importance of armament and armed forces—national defense amply commensurate with the particular requirements of each individual sovereign

[1] Editor's Note: See page 1391 "Discussion."

state —as a necessary adjunct in consummating any plan for definitely averting war. Truly, a healthy and practical fundamental premise, to say the least, and one which should augur well for the future development of the movement and in advancing it along the road—even though it be ever such a long, long trail—to a successful realization of the ideal.

And, although it may be said that it was as a result of the World War—the effects of which were felt in some measure in every hamlet on the globe— that this world-wide movement received its greatest impetus, the tap-root of that movement goes down much deeper into the history of the world. Furthermore, just as the horrors and suffering of that war reacted in imparting to that movement its greatest impetus, the movement itself had its very inception in the horrors and suffering of another sanguinary conflict staged on the European continent—the Thirty Years' War. For acting under the inspiration of the teachings of Grotius, and as a means of averting war, the European nations, shortly after signing the Treaty of Westphalia, 1648, entered into a series of agreements by which were formulated rules of international conduct in recognition of certain rights common to all. This also may be said to have been the beginning of what is our modern conception of International Law.

The next phase in the development of the movement for promoting international accord through recognition of certain rules of conduct among nations was that in which a group of governments instituted the practice of convoking conferences and conventions for the joint consideration of matters and issues of more or less common concern to all, such as the Paris Conference of 1856, the Berlin Conference of 1878, the Madrid Convention of 1881 on Moroccan affairs, and also the supplementary one of 1906 on the same subject, the Conference of Algeciras. Of course, in addition to the foregoing conventions and conferences, which were more or less of a politico-diplomatic character, there have also taken place from time to time many others in the domain of the world's commercial and scientific development, and having as their prime objective the effecting of convenience and expedition in regulating and progressively carrying on world business and the preservation of life and health. Such conventions are commonly referred to as "mutual convenience arrangements," and cover such subjects as railways, telegraphs, radio, postal service, quarantine,

money, patents, trade-marks, copyrights, weights and measures, longitude and time, shipping, navigation, etc. Those conventions and arrangements have moreover played a prominent part in the field of developing world legislation, and as we glance backward over the pages of history they stand out in bold relief as stepping stones over which the world has passed on the march which has brought us to the threshold of a new era in international legislative endeavor.

Outstanding examples of the above conventions are: the Universal Postal Union which originally convened at Berne, Switzerland in 1874, and which covers the postal regulations which now obtain throughout the world; Convention of International Sanitation at Washington, in 1881, covering the subject of quarantine; International Marine Conference at Washington, in 1899, and out of which came the "International Rules of the Road;" Convention on use and management of Wireless Telegraphy, at Berlin in 1906, and International Congress for Adopting a Common Meridian, at Washington in 1884. It is of interest to observe that many of the above conferences and conventions quite naturally apply to subjects intimately associated with the seafaring profession, and it is particularly interesting to naval men to note that in the case of the international congress for adopting a common meridian, among their recommendations was that "the conference proposes to the governments here represented the adoption of the meridian passing through the center of the transit instrument at the observatory of Greenwich as the initial meridian for longitude." In consequence, therefore, it seems clear that to that conference may be attributed in large measure many of the trials and tribulations experienced in our midshipman days when, within a stone's throw of Lover's Lane and under the ever watchful care of Tecumseh, we shot into an artificial horizon and laboriously endeavored to "find the correct G.M.T. and date" while old Sol hovered around in the neighborhood of the Crabtown meridian!

The calling of the First and Second Hague Conferences of 1899 and 1907, respectively, constituted the next logical and very important steps in the development of the movement for promoting harmonious international relations. Through those conferences the element of judicial procedure and the principle of arbitration—an international tribunal—were injected into the scheme for settling disputes between nations without recourse to war. It is here

gratifying to observe that our own government played a highly important part in the development of this particular phase of the movement. Moreover, on viewing at this point the current phase of international affairs, and as applying particularly to Russia and the present status of her relations with other powers, an interesting trace of historic irony suggests itself when we recall that the First Hague Conference was convoked at the instance of the Czar of Russia. One therefore wonders what will be the effect on international affairs when the Muscovite again assumes his place at the table in the council chamber of nations.

Although one must admit that the efforts put forth by the above mentioned assemblies and tribunals in furthering the movement for peace have not been crowned with success in every sense of the word, owing mainly to the refusal—or failure, at any rate—of some of the contracting parties to abandon their traditional practices of intrigue in the practical application of the accepted rules of international conduct, it must nevertheless be said that some progress has been made, the World War notwithstanding. That small progress, is the one ray of hope which filters through the present cloudbank of international distrust, and upon which the leaders of the movement pin their faith for achieving the objective—an orderly, lawful method of preserving international accord.

That meritorious movement for improving international relations received a severe jolt when the World War broke forth. It is nevertheless true that out of the many vicissitudes of the long drawn-out peace negotiations came the next step—however feeble it may have been—in the development of that movement. It is not in any sense of the word the purpose of this article to defend the League of Nations as constituted under its present covenant, but rather to emphasize the fact that when we dig down under the opaque strata of political faction and partisan agitation, we discover unmistakable evidence that the world as a whole has derived some benefits from the League, even though it is imperfect as viewed from our own national standpoint. At this point it is pertinent to observe that among the serious objections which have been raised in support of our own government's refusal to subscribe to the present covenant may be included the following: not sufficient specific emphasis placed upon exempting Monroe Doctrine from consideration by League; neutral nations took little or no part in drafting the covenant, hence it does not fulfill universal require-

ments of an agency for preserving peace of the world; the obligations of the covenant distinctively involve war; it contains no declaration of rights, and members are not bound by any statement of judicial principles; it is not founded on juristic basis; it does not unreservedly adopt International Law as a standard of conduct; the League is in its essence a defensive alliance of a limited group of powers against the rest of the world and it commits the whole future policy of the United States to the decisions of an international body in which it would have only a single voice.

Granted, then, that as considered strictly from the American point of view serious imperfections do exist in the present covenant of the League of Nations, that body, nevertheless, has accomplished some constructive results which have reacted in the interest of the world at large, not only in bringing about peaceful settlement of disputes, but in other spheres of international endeavor as well, the Greek-Italian flare-up over the Corfu incident and the Greek-Turkish War notwithstanding. Furthermore, those results have been achieved through the joint and harmonious action of the many nations comprising the membership of the League, deliberating in common council around the conference table, all striving for a common end—the peace of the world. Thus, in addition to the different value of the results themselves as achieved through the joint deliberations of the accredited representatives of the various nations, there is another phase of the matter which has also reacted to the direct interest of the world at large, in the mere fact of those representatives of many nations—coming as they do from the four quarters of the globe—collaborating in common council and bringing to bear a unity of purpose and effort in attempting to adjust matters of international concern.

It is here, therefore, that the writer would stress the latter phase of the League's value, and it is that phase which has prompted the mention of that body in this article. For it serves to illustrate the world's trend of thought in developing and giving directive force to the movement for preserving the peace of the world by promoting orderly and harmonious processes in improving international relations, as a result of the get-together spirit engendered through the agency of such a gathering, society, league or conference of the nations of the world. In other words, such an international gathering, assembling periodically, is conducive to bringing about an international public opinion on world issues, and preserv-

ing international peace, as well as enlisting world-wide support of established rules for international conduct. And then, too, the present League has proven of value at this particular stage of the world's history through its creation of a World Court—the Permanent Court of International Justice. This may be said to have marked the next important step in the development of the international accord movement, which as time goes on is destined to play a considerable part in improving the status and in broadening the application of International Law.

In viewing in restrospect at this juncture the whole situation of international relations, who knows but what it may have been an act of Providence to cause the world to undergo the ravages and suffering of the greatest war in all history in order to rivet attention and educate the peoples of the earth to a proper appreciation and realization of the necessity of creating some duly appointed international mechanism for preserving the peace of the world, and of according to it adequate moral support for making it effective. At any rate, following closely in the wake of that war, and in accordance with provisions of Article XIV of the covenant of the League of Nations, which stipulates that "the Council shall formulate and submit to the members of the League for adoption plans for the establishment of a Permanent Court of International Justice," a commission consisting of some of the foremost jurists of the world, including Mr. Elihu Root, meeting at The Hague, in 1920, evolved a plan and reached unanimous agreement on all its details for creating such a court. That plan formed the basis upon which the League acted and which brought into being the present World Court, thus constituting one of the League's major achievements to date.

Although our own government has shown no formal inclination to accept the present covenant of the League, and while it is true that the World Court was born of that covenant, there is unmistakable evidence that the country had been building up sentiment favorable to bringing about our official acceptance of the Permanent Court of International Justice, with, of course, certain specific reservations. As indicative of this President Coolidge in speaking of the World Court in his inaugural address stated that:

> In conformity with the principles that a display of reason rather than a threat of force should be the determining factor in the intercourse among nations, we have long advocated the peaceful settlement of disputes by

methods of arbitration and have negotiated many treaties to secure that result. The same consideration should lead to our adherence to the Permanent Court of International Justice. Where great principles are involved, where great movements are underway which promise much for the welfare of humanity by reason of the very fact that many other nations have given such movements their actual support, we ought not to withold our own sanction because of any small and inessential difference, but only upon the ground of the most important and compelling fundamental reasons. We can not barter away our independence or our sovereignty, but we ought to engage in no refinements of logic, no sophistries and no subterfuges, to argue away the undoubted duty of this country by reason of the might of its numbers, the power of its resources, and its position of leadership in the world, actively and comprehensively to signify its approval and to bear its full share of the responsibility of a candid and disinterested attempt at the establishment of a tribunal for the administration of even-handed justice between nation and nation. The weight of our enormous influence must be cast upon the side of a reign not of force but of law and trial, not by battle but by reason . . . .

In the following session of Congress (last winter) the Senate passed a resolution signifying our willingness to adhere to the Protocol of Signature of the Permanent Court of International Justice, subject to certain specific reservations, and our joining the Court is therefore contingent only on the approval of these reservations by the nations now members. Therefore, a brief summary bearing upon the organization, administration, and some of the functional details of the World Court should prove of more than passing interest.

In the first place, representatives of forty-eight nations signed the treaty creating the World Court, while to date thirty-seven governments have ratified it. The first election of judges took place at Geneva, in September 1921. The court has now been functioning for over four years and is available as a tribunal to all nations of the world. The court comprises eleven judges and four deputy-judges, who were elected from a list of names submitted to the Council and the Assembly of the League of Nations by members of the old Hague Court. In electing the judges the Council and the Assembly ballot separately, thus maintaining independence of action by those two bodies in the selection of the judges, and thereby preserving equilibrium as between the choice of the large and small powers belonging to the League. Although the United States has not joined the court, an American jurist, Mr. John Basset Moore, was among the first elected to the World Court

bench. The first meeting of the judges took place at The Hague in February, 1922, at which time they organized themselves into a court body, and formulated rules of procedure for the routine adjudication work of the court, as well as in rendering advisory opinions. The rules of the court are seventy-five in number, while one of the important provisions of the statute of the court is that a session is required to be held each year, beginning on June 15, unless other arrangements are made. The statute of the court also provides for a Chamber of Summary Procedure. While the old Hague Court—the Permanent Court of Arbitration—and the new World Court both sit under the same roof—the Hague Peace Palace—certain salient differences exist in their composition and administrative structure. For whereas the old Hague Tribunal comprises only a panel of arbitrators each of whom is available for selection by parties submitting their controversies to the court for arbitration, the new World Court has permanent judges who come together at stated times in joint deliberation for the adjudication of cases voluntarily submitted to it, while also in certain specific types of controversies the court is vested with compulsory jurisdiction. In the trial of cases making up the international docket, not only is full opportunity given to all interested governments to appear before the court, but private parties or organizations are also given an opportunity to present their views. During the first three years of its existence the World Court handed down three judgments and ten advisory opinions bearing upon international affairs, and in each case the judges had the benefit of extended argument by eminent counsel to assist them in their deliberations before passing judgment or rendering opinions.

Now, as a sort of postscript to the foregoing information relative to the World Court, and in connection with this phase of our subject it should be reiterated that arbitration and peaceful settlement of international controversies are traditional American principles. Even prior to the First Peace Conference at The Hague the United States had participated in fifty-seven arbitrations. And Uncle Sam has always been strong for the administration of international justice according to law. Moreover, although the World Court as at present constituted is not perfect in every detail as an international tribunal, it is believed that it marks the nearest approach towards that juridical goal which the world has long been striving to attain. It is also believed that it may be asserted

without fear of successful contradiction that that court at least constitutes a move in the right direction for setting the international ship of state on the correct course for improving and maintaining harmonious world relations through orderly processes of internationally accepted law. And, furthermore, that through the jurisprudence produced by its routine functions the court will prove a dynamic factor not merely in still further developing International Law, but in bringing about practicable codification of some of its diverse phases, it matters not whether that be by a restatement of existing law—the so-called law of custom—in revitalized terms of the new world order of things, or whether it be by enacting new legislation designed to meet the demands of present-day world society. By exercising its muscles as far as may be practicable on the international problems which exist today the World Court will itself undergo development, and, like all things created by man, will be just as good and effective as the civilized nations of the world choose to make it—and no better. Its success, therefore, will be in direct proportion to the moral support accorded to it by the governments of the world.

The next outstanding event in the domain of international conference effort was the Washington Conference of 1921, and the enactment of international legislation incident to the ratification by the various governments of the treaties growing out of that conference.

Although it failed of ratification it might be well in passing to mention the so-called Geneva Protocol proposed by the Fifth Assembly of the League of Nations, in 1924, and which was designed to bring about specific settlement of international disputes. Of special interest was the provision which it contained for calling another international conference for the reduction of armaments at Geneva on June 15, 1925. There were many other features covering a wide field and based particularly upon the premise that the three subjects of compulsory arbitration, security, and disarmament are so intimately related that they must be considered as a unit in solving the problem of which they are factors. The protocol also incorporated certain features of a draft treaty of disarmament and security, designed to bring about outlawry of aggressive war, as prepared by an American committee and submitted to the League of Nations. It has been very appropriately pointed out that the protocol constitutes another attempt at equipping the

League of Nations with a good set of sharp teeth. However, Great Britain refused to ratify the protocol.

Now reverting to the subject of International Law with specific reference to what the immediate future holds for its further development and codification, it is of interest to point out that eminent jurists are now devoting considerable time, thought, and energy to that important task. Two special commissions of jurists —one on each side of the Atlantic—have been appointed for this purpose, and it is of additional interest to note that the new world took the initiative in this movement and was the first to appoint a commission of experts from the Americas to undertake this work. Since then a similar commission has been appointed by the League of Nations and is now functioning in the old world.

The appointment of the American international commission of jurists for undertaking the work of codifying American International Law came about as a result of action taken by the Fifth Pan American Conference which convened at Santiago, Chile, in 1923. That commission of American jurists was scheduled to meet some time in 1925 at Rio de Janeiro, but as a preliminary expedient the governing board of the Pan American Union requested the assistance of the American Institute of International Law in preparing some draft conventions to be used as a basis for the work of the jurist commission. The American Institute of International Law completed its work and the draft conventions were afterward submitted to the governing board of the Pan American Union and in turn to the foreign offices of the American republics, for use of the commission of jurists at Rio de Janeiro. There are thirty-one of the draft conventions, and while they are based upon the affirmation of the reliance of the American republics on the general principles of international law, they assert the right to reject or protest against any rules in force in the old world which may contradict American independence and sovereignty. Those draft conventions embrace a wide range of subjects bearing upon the relationships of the republics in this hemisphere, and include a proposal for outlawing aggressive wars of conquest among American republics; cover commerce and communication by land, sea, or air; deal with difficult questions of diplomatic recognition of new nations and governments under a definite code of rules; lay the ground work for regularized exchange between the state of educational publications and educators; propose a unified system of

dealing with extradition, and point out that completion of the codification of American International Law, on which a start is to be made, is necessarily a progressive work to be followed up year after year.

The committee of jurists on the other side of the Atlantic to engage in work with the view of bringing about a progressive codification of international law was appointed by the council of the League of Nations, in accordance with a resolution passed on September 21, 1924, at the Fifth Assembly of the League, which resolution was introduced by the Swedish delegation and called upon the council to invite suggestions as to "the items or subjects of International Law, public or private, which may be usefully examined with a view to their incorporation in international conventions . . . . in order to enable the League of Nations to contribute in the largest possible measure to the development of International Law."

It is thus manifest that the whole subject of International Law is now engaging the serious attention of the entire world and is causing civilized peoples in every land to devote thought to it as never before in the world's history, which in turn will bring about a universal state of mind favorable to its further development. In truth, therefore, it may be said that we are on the threshold of a new era in International Law, and the next decade should bring forth marked progress in the realm of world legislation and in the interest of international harmony. Moreover, by nature of things, development in that sphere commands the special attention and interest of the naval profession.

The foregoing chronological train of movements is but an index to the progressive history of international effort in organizing the world for orderly, lawful, and cooperative methods of carrying on its business, and is indicative of the trend of the world's best thought in that field. Another encouraging aspect of this subject of developing a world-wide state of mind or opinion favorable to universal recognition of the underlying principles of International Law as a necessary instrument for promoting and maintaining harmony in the very diversified phases of international intercourse is that of the growing interest manifested by the peoples of the world in international affairs. That, however, is quite natural since the more that the peoples of the world know of each other the more interested they become, and the broader becomes their horizon

of appreciation and toleration of the other fellow's point of view, and, consequently, the more apparent it becomes to all that it is necessary to formulate and universally adopt some authoritative system of regulation or law for governing international intercourse. Indeed, all factors being equal, it may even be asserted as a maxim that the chances of decreasing aggressive war are enhanced in direct proportion to the increase in international understanding and toleration of the other fellow's point of view, when coupled with an abundant flow of the milk of human kindness over the surface of this old globe. Although of a ripe old age the Golden Rule has not suffered from overwork in an international sense and still constitutes an excellent measuring rod for gauging and establishing codes of international conduct. And one of the hopeful signs of the times, as we round the first quarter post of the twentieth century, is the growing tendency among the peoples of every land to recognize and appreciate the fact that that ancient rule is the very essence of the principle upon which International Law is founded.

Another hopeful sign is that this growing interest in international affairs is particularly noticeable among the people of our own country. Today world events and affairs are discussed in women's clubs and barber shops on Main Street in America with as much interest and enthusiasm as was the community gossip by woodwhittlers around the stove in the country store, before the automobile and good roads and radio relegated that national institution to a past age. Moreover, this has come about in large measure through our experiences in the World War and the accompanying national realization that, owing to the intensive and close-knit order of financial, commercial, and social activities of the world as at present organized, and the consequent inter-dependent nature of conditions under which the nations of the earth exist today, the Atlantic and the Pacific no longer serve as an asbestos curtain for shielding us from the scorching flames born of armed conflict on the stage of other world powers.

It should also be stated that another contributory factor to the increased interest manifested by the peoples of the world in international affairs is that of the modern improvements which have taken place in the realm of world communications—the annihilation of time and space through the advent of the cable, telegraph, and the phantom-like transmission of the spoken word by radio, all of which have so dynamically supplemented that powerful and im-

portant moulder of public opinion, the printing press. In consideration of the subject from that angle one has but to turn back a few brief pages of our own American history to discover what a sharp contrast presents itself when we compare the modern stage of development attained in the art of world communications with that of yesterday, as for instance during the War of 1812, when in absence of news from Europe that the Treaty of Ghent had been signed on December 24, 1814, the American and British armies fought the famous battle of New Orleans on January 18, 1815, or over two weeks after the treaty of peace had been signed. Furthermore, news of the signing of that treaty did not reach the shores of the western hemisphere until the arrival at New York, on February 11, 1815, of the British sloop-of-war *Favorite,* the bearer of that celebrated news across the Atlantic. In other words, over a month and a half had elapsed since peace had been formally declared before the American and British forces on this continent received news of it, thus costing both countries needless losses in both men and treasure. When we compare that historical incident with that of the phenomenal rapidity which characterized the passing around the world of the news of signing of the Armistice on November 11, 1918, the contrast is strikingly significant. Moving pictures have also played their part in arousing interest and educating the peoples of the earth in world affairs; an inaugural ceremony at Washington is now reproduced in all its pomp and spectacular effect with as much interest and entertainment to the peoples who inhabit the steppes of central Asia as to the shell-spangled natives of the south sea isles, or the igloo dwellers of the Arctic regions, while a boy scout parade in Hong Kong or the picturesque setting of a treasure-laden caravan wending its weary way across the hot sands of the Sahara is projected in all its native brilliance and color with equal interest and amusement within the very glow of the lights of Broadway. People also travel more extensively now than at any other period of the world's history, and travel is universally recognized as having a liberalizing influence upon peoples through affording friendly, interesting, and profitable contact with other societies and civilizations. And it is not inconceivable that a universal language may yet be evolved as a result of the girdling of the globe by radio telephone waves which are increasing by leaps and bounds in number as well as points of origin. The English language is already being used in

many foreign countries for announcing radio programs. All of those globe-contracting factors will continue to exert a forceful influence in developing international understanding and in making increasingly apparent the necessity for the existence of International Law, while its codification in some degree or phase and further development will be brought about in due course. And that day is not far off.

A very potent indication of the development of international interest among the people of our own country is the increased space given over to foreign affairs in the American press, and also the gradual increase in enrollments in political science courses at our colleges and universities, as well as the material increase in the number of societies which have been organized throughout the country having as their prime objective the study of foreign affairs to the end that our citizenry may become better versed in the details of international relations. It is thus clear that considerable effort is being put forth in an attempt at reducing to a scientific basis the preservation of the peace of the world, and one of the essential reagents being utilized in the statecraft test tubes for evolving a world peace formula is international understanding—a substantial stepping stone to a realization of International Law and the full fruition of its underlying principles. Other realities which presage a new era in international judicial procedure are that the American Bar Association maintains a standing committee in the interest of developing International Law, as also the existence and purposes of the American Society of International Law, while such annual gatherings as the Institute of Politics at Williamstown, Massachusetts, and the Norman Waite Harris Memorial Foundation at the University of Chicago, offer added significance in mirroring this trend of thought in improving international relations and in bringing about orderly practices in world intercourse. A keynote of this line of thought is sounded in the following which is quoted from the endowment letter establishing the Harris Memorial Foundation in 1923.

> It is apparent that a knowledge of world affairs was never of more importance to Americans than today. The spirit of distrust which pervades the old world is not without its effect upon our own country. How to combat this disintegrating tendency is a problem worthy of the most serious thought. Perhaps one of the best methods is the promotion of a better understanding of the other nations through wisely directed educational

effort. The purpose of the foundation shall be the promotion of a better understanding on the part of American citizens of the other peoples of the world, thus establishing a basis for improved international relations, and a more enlightened world order. The aim shall always be to give accurate information, not to propagate opinion.

Obviously, therefore, it is of transcendent importance that every naval officer be an ardent student of foreign affairs and well versed in International Law. And especially is this true in this age in which international contracts, pacts and adjustments are studied and negotiated on bases which in many instances are primarily of a politico-naval character—for example, the Washington Limitation of Armament Conference. Even as these lines go to press a rear admiral of our Navy is sitting, at Geneva, as a technical advisor to the American delegation to the Preliminary Conference on Limitation of Armament. And as time goes on there will be many other occasions in which naval officers will be called upon to perform duty of that same general nature. Let us therefore be always ready.

Accordingly, it is important that we keep our eyes open and our ears close to the ground and be ever alive to any international developments or changing phases of international relations, in order that we may not merely interpret world events in their outward or superficial aspect, but may also be able to read between the lines, so to speak, and thus to discern and intelligently correlate the pertinent antecedents to any changing scenes on the stage of world affairs, and, finally, to the end that we may attain a thorough understanding of the trend in international affairs, thus keeping abreast, professionally, of the most advanced international thought and opinion.

THE CORDITE OF THE "AQUIDABAN"

By Alvaro Alberto

Translated by Lieutenant Commander W. R. Carter, U. S. Navy

Translator's Note: The *Aquidaban* was a vessel of the Brazilian Navy somewhat similar to our old *Texas,* having two echelon 8-inch turrets, the forward one being on the port side and the after one on the starboard side. In addition she carried a battery of eight or ten 4.7 guns.

In 1906, carrying on board a commission of high officers, several admirals and captains, she steamed from Rio to Ilha Grande Bay, a distance of about seventy miles. It was the purpose of the commission to determine the feasibility of establishing a naval base in that bay. Opposed to this idea there was a strong political faction both within the navy and without.

The vessel anchored and at about eight o'clock at night she was destroyed by an internal explosion of the after eight-inch magazine. While we are not technically interested in the history of the affair, there is, however, a point brought out by the investigation which is of technical interest, and that is the remarkable stability and homogeneity of the cordite after being immersed in sea water for fourteen years. With a powder of similar insensibility to sea water it would be quite practicable to flood a magazine in time of danger and afterwards to pump out and go into action or renew the action again with the same powder. Can we do this with our smokeless powder? This article is translated from the *Boletim do Club Naval* of Brazil.

IN CONNECTION with the previously made study of the cordite taken from the submerged hull of the *Aquidaban,* we return to the subject in order to mention new data, some of which it would not be proper to omit.

By the letter from Sir A. G. Hadcock, dated July 26, 1921, we verified that the cordite which was supplied to the *Aquidaban* had been originally manufactured for this battleship in 1898, and was from the factory of the Chilworth Smokeless Powder Company.

At the time the explosion occurred the powder had been kept in the magazine about eight years under conditions upon the extreme precariousness of which we have already commented.

The examination of the samples obtained showed that the chemical stability was not greatly altered as might have been expected of a powder twenty-two years old.

Admiral Severiano de Castilho, eminent naval engineer, sent to the firm of Armstrong of Newcastle a small portion of the cordite which had then been taken out by divers from the magazines of the *Aquidaban*. Sir A. G. Hadcock made an analysis of these samples, which were from the propellants designated respectively for the 8-inch and 4.7-inch guns.

The illustrious English technicist gives us the interesting results of his inquiry, which we reproduce with much satisfaction as they are in complete accord with those which we had already arrived at. The confirmation follows:

Data given by the cordite at the time of its receipt in 1898.

Lot 396 for 8-inch gun.

Nitrocellulose, soluble	2.62%
Nitrocellulose, insoluble	36.10
Nitroglycerine	56.69
Vaseline	4.59
	100.00

Loss of weight by heating 1 hr. at 150° F. = 0.7% Density 1.565.

Lot 402 for 4.7-inch gun.

Nitrocellulose, soluble	3.47%
Nitrocellulose, insoluble	35.10
Nitroglycerine	56.86
Vaseline	4.57
	100.00

Loss of weight by heating 1 hr. at 150° F. = 1.0% Density 1.572.

In 1921 the samples taken from the submerged hull gave, according to Sir Hadcock, the following results:

Cordite for 8-inch gun.

Nitrocellulose, soluble	5.27%
Nitrocellulose, insoluble	36.22
Nitroglycerine	53.40
Vaseline	5.11
	100.00

Humidity 0.22 per cent.
Test of stability at 180° F. 9 minutes.
Density 1.567.
Point of ignition 336° F.

Cordite for 4.7-inch gun.

Nitrocellulose, soluble	6.66%
Nitrocellulose, insoluble	40.21
Nitroglycerine	47.62
Vaseline	5.51
	100.00

Humidity 0.25 per cent.
Test of Abel at 180° F. 9 minutes.
Point of ignition at 334.4° F.

Noting these results, Sir A. G. Hadcock calls attention to the fact that both the samples examined stood the test of stability for nine minutes in spite of the advanced age of the powder.

We (at the time of our analysis) were only able to obtain sample of 4.7-inch ammunition. In connection with the powder of this ammunition however, the agreement of the greater part of the measurements which we found to those referred to us would extend also to the results of chemical analysis of different samples. Thus, for example, proportioning the ingredients by approved process; at the end of 1920 we got for one of the samples in question:

Nitrocellulose, soluble	6.8%
Nitrocellulose, insoluble	41.1
Nitroglycerine	46.8
Vaseline	5.3
	100.00

A result which practically equals that found by the director of the firm of Armstrong and which shows for the powder a loss of nitroglycerine of about 11 per cent in weight, a loss that that technical authority attributed to evaporation of the liquid and considered perfectly normal data for the existing conditions.

It is clear that we cannot make an exact analysis of samples whose state of damage was evident, as was proved by the tests for stability. We are not interested with the approximation of the second place decimal in the percentages of the constituents, in view of the irregularity of the measurements of the various samples.

It was proper that on three different trials of the best samples, we should investigate also for the possible presence of perchloride of mercury which would, with the tiny dose of 1/1000 milligram, annul completely the significance of the Abel test.

Adopting the current technical German method of Kast (Post et Neuman, *Analyse Chem.* p 347), a search for mercury in the nitro-cellulose extracted from the powder gave negative result in the three tests, as the pure gold leaf impregnated with the reagent presented no visible indication of amalgam, it not having been possible to form iodide of mercury.

Simultaneously we made a verification of this result by the employment of the spectroscope; as is preferred by English technicists.

Having communicated to Sir A. G. Hadcock this first evidence of the non-existence of mercury in the cordite, he replied by letter of 26 August, 1921, his entire confidence in the confirmation of such results.

We cannot then support here as conforming to our other study of the subject the hypothesis that there was an explosion of the magazine of the after turret of the *Aquidaban* provoked by an initial explosion of the boilers.

The chief of divers, Mr. Ogapito, who repeatedly penetrated the submerged hull, declared to us that the damages in the boiler compartment, owing to there having actually been an explosion of the magazine, were greater on the side of the magazine than on the other.

Lieutenant Ormando Roxo and First Lieutenant Manoel Barbosa de Santa Anna, witnesses present at the accident, did not see any escape of steam at the beginning of the explosion; referring to the latter, however, as a peculiar noise, like a rapidly rising shriek followed by strong explosions. This would explain itself easily by the burning of a charge of powder propagating itself to others, from which the liberation and escape of gases produced the noise mentioned. Then the great and rapid rising of temperature could have caused the successive explosions of the remaining charges.

From all of which it appears permissible for us to form the followng conclusions:

I. The cordite first taken from the 4.7-inch ammunition from the submerged hull of the *Aquidaban* in October, 1920, showed some alteration as regards the percentage of its constituents, and as regards the homogeneity and consistency of the colloid; it was not, however, all in a bad condition of chemical stability, having strands which still presented results satisfactory in heat tests, in spite of the age of the powder, which according to Hadcock

was more than twenty-two years; and, in spite of the high temperature to which it was frequently exposed before submersion.

II. It is very probable that the fact of having been submerged in the sea has contributed to moderate the progress of the damage of the powder, as during that time it has been subjected to temperatures very much lower and less variable than those in the magazines of the *Aquidaban*.

III. The fact of finding still more strands of cordite in a state of conservation above that which could be foreseen, does not authorize the dismissal of "spontaneous combustion," as the probable cause of the disaster.

IV. The solution of the probable cause of the explosion is, we think, an indeterminable problem. It should not be left without impressing the fact, that the explosion was produced precisely where the conditions of temperature for it were exceptionally favorable, because the magazine of the after turret, which exploded, was interposed between the boilers and the engines. Furthermore, it was adjacent to a group of dynamos, in which compartment the thermometer registered at times more than 140° F.

V. The conditions in which the cordite was stored would have provoked a rapid decomposition in any smokeless powder, single or double base, and the risk of spontaneous combustion would have been practically the same for any.

SPECIAL NOTICE

Please read the leading note in Secretary's Notes relative to possible changes in the make up of the PROCEEDINGS.

DISCUSSION

Limitation of Naval Armament

(See page 427, March, 1926, PROCEEDINGS.)

The Naval and Military Record, 31 March, 1926.—In the course of an interesting article upon "The Limitation of Naval Armament" which he contributes to the March number of the UNITED STATES NAVAL INSTITUTE PROCEEDINGS, Capt. Walter S. Anderson, U. S. Navy, reviews the disabilities under which his country labors in consequence of the Washington Agreement. We have always held the view that the United States gave away more than she gained on that occasion. In almost academic terms, so moderate and judicial in his language, Capt. Anderson categorically deals with the disadvantages which America has incurred in her naval position in the international pact, which her initiative brought about. In the first place, he points out that the United States had to "sacrifice eleven partially-completed heavy warships, battleships, or battle cruisers," whereas Great Britain only scrapped four, "in such an early stage as to be referred to as built or building." This had no effect upon the balance of power as settled by the Treaty, but it meant a very heavy monetary loss to America, as against a relatively light one on the part of this country.

More serious still, in his view, is the contemplation of the character of the ships America was called upon to forego. The program which was "scuppered" was an attempt to remedy one grave defect in the composition of the United States fleet—the absence of battle cruisers. Great Britain and Japan each retain four battle cruisers. "These great heavily-armored ships, carrying guns of battleship caliber, can also make high speed. They have speeds of about 28 knots an hour. No United States battleship can exceed a small fraction more than 21 knots. What is the United States to do if its commerce be attacked by battle cruisers? The United States has nothing that could overtake a battle cruiser that could not be promptly blown out of water by a battle cruiser." This is, perhaps, rather an extravagant view, since battle cruisers are certainly not designed for commerce raiding. However since there are none of these vessels in Capt. Anderson's Navy, he probably has not given much heed to their rôle. He comes to the conclusion that "the lack of battle cruisers may yet spell national disaster for the United States," and under the Washington Treaty she cannot begin to remedy this lack until 1933.

OTHER POINTS

The attitude of the British Admiralty in declining to approve of any increase of turret-gun elevation in the earlier United States battleships Capt.

Anderson regards as very unfair. He declares that thirteen battleships require to possess this greater elevation. "At present they are outranged by the guns of the British battleships, because the latter have the greater angles of elevation. . . . . The responsible authorities state that the older retained battleships of the United States require extensive betterments. They need to be reboilered, to be converted to oil-burners, and to have more horizontal deck armor as protection against aerial bombing. They also need 'blisters' or bulges of the hull at the turn of the bilges, or similar provision to protect them from underwater attack, in the same way the British ships have been protected." We fancy Capt. Anderson is carrying his lament a little too far here. As we are "bulging" our *Queen Elizabeths* the United States is at equal liberty to "bulge" her earlier battleships. The Japanese, he says, are so sure of their right to increase turret gun elevation "that they actually have increased theirs." The Japanese officially declare that they have done nothing of the sort.

When Capt. Anderson comes to the restrictions upon the development of United States naval bases in the Eastern Pacific he touches what, in our opinion, is by far the most serious disability imposed by the Washington Treaty.' Japan insisted that while the capital ship ratio proposed by the American Government might be acceptable under existing conditions, it could not be regarded as acceptable by the Japanese Government if the Government of the United States should fortify or establish additional naval bases in the Pacific. It has always been a source of surprise on this side of the Atlantic that America should have agreed to such a stipulation; but there is the fact. As a result, her battle fleet has nowhere to go beyond Hawaii, in the event of war, while the Japanese possess a swarm of potential "flying" bases in the mandate islands.

It is clearly realized in the United States Navy that Manila and Guam would promptly fall to attack by Japan, and that the task of recovering these places, with no base to work from nearer than Honolulu, would be a very serious undertaking. The Pacific fleet is well equipped with auxiliaries to enable it to maintain itself at sea for some weeks. But as the line of communications lengthens, so do the difficulties increase. Capital ships absolutely must have a base from which to carry on operations. America virtually gave away the keys to her strategical strength in the Pacific when she ratified the Washington Treaty. British policy in developing Singapore renders her only the more keenly conscious of the fact.

Navy Service Schools

(See Page 691, April, 1926, PROCEEDINGS.)

LIEUTENANT COMMANDER B. F. TILLEY, U. S. NAVY.—1. Commander Oscar Smith's article is very interesting particularly to officers now doing sea duty as heads of repair departments on repair ships and tenders. Thanks to the excellent service schools now functioning at the Naval Training Station, Hampton Roads, Virginia, the fleet is gradually obtaining these ex-

cellent men, and most ships are today in a position, for the first time in several years, to fill their allowed ship's complement in machinist's mates, boilermakers, blacksmiths, coppersmiths, and electricians. The mechanical and electrical divisions of this school are turning out very good to excellent material as shown by the aptitude and rapid advancement of the school graduates once they report on board ship. Not very long ago my ship received six graduates of the Hampton Roads Machinist's Mate School. All are now machinist's mates, second class, one of whom already has the qualifications for chief machinist's mate, while two others of the six show that they will be first class machinist's mates within two years, the time prescribed by the Bureau of Navigation. As I have had no supervision of men graduating from the general division of the school, I cannot comment on the graduates from this division.

2. The system and curriculum outlined by Commander Smith could not very well be improved upon. It is, in my opinion, a much better method to select men from the recruits at training stations, instruct and apprentice them in their trades ashore prior to their reporting on board ship, rather than to send candidates from sea to the school. Second cruise seamen and firemen have not the ambition of the recruit if the latter is above average in intelligence. I am not favorable to reducing the courses in the machinist's mates and electrial schools from thirty-eight and thirty-two weeks respectively to fifteen weeks.

3. The service schools should be maintained as at present, reducing the number of graduates as allowed ship's complements fill up in the fleets. It has been observed that graduates from these Navy service schools adapt themselves very quickly to military duties on board ship. In fact these men stand out in all-around ship's work and military duties. All graduates of the schools on this ship have qualified in swimming and all have qualified as marksmen or better the first time they ever fired a rifle on the range.

4. With these excellent service schools in being, one wonders sometimes if a boatswain's mate or coxwain's school at training stations would not be an asset to the service these days. The art of sailing a boat is now almost a curiosity and on most ships, when a life boat is lowered at sea, the rowing and boat handling is usually a terrible exhibition of elementary seamanship. Why not a school for boatswain's mates and coxswains to make them qualify as real seamen? This school might consist of a two or three months' concentrated "post graduate" seamanship course at the Newport Training Station or at St. Helena, prior to rating the men. We have many deck petty officers who cannot splice either rope or wire and who cannot sail a boat. Only a comparatively few deck petty officers can efficiently take out a life boat in a rough sea. Recently I heard an old-time chief boatswain with about thirty years service say in distraction, "Oh, for a couple of Swedes!" meaning his present deck petty officers were poor seamen in comparison with those of former days.

Although the service schools are turning out excellent material for machinist mate and artificer ratings no provision is yet existent for obtain-

ing what is now required most of all—some real sea-going seamen for our deck petty officer ratings.

The Threshold of a New Era in International Law

(See Page 1367, July, 1926, PROCEEDINGS.)

New York Times, 5 May, 1926.—Washington, May 4.—Codification of International law by the League of Nations would not suit the purposes of all the world powers nor perform the services in this regard required by the present state of world affairs, according to Dr. David Jayne Hill, former Ambassador to Germany, who discussed the subject today before the House Foreign Affairs Committee.

Dr. Hill, who appeared before the committee to urge favorable action on the resolution offered by Representative George H. Tinkham of Massachusetts requesting the President to call a Third Hague conference for the codification of international law, declared that the League of Nations had treated international law as a secondary matter.

The suggestion for such a conference contained in the Tinkham resolution does not appeal to the President as worthy of consideration at this time because of the vital and more pressing questions pending before the nations of Europe.

The President feels that the countries of Europe are all concerned with their own affairs and, therefore, would not feel disposed at this time to join in another Hague conference to consider clarification of international law.

Dr. Hill told the House Committee that the League of Nations had rejected the unanimous recommendation of its Committee of Jurists, selected to propose a statute for the Permanent Court of International Justice, that a series of conferences be held at The Hague for the advancement of international law.

"It is true," said Dr. Hill, "that after refusing to accept the advice of this committee, the League has assumed the task of the codification of international law under its own auspices and control.

This assumption of control by a single group of powers will, however, be regarded by many persons as a denial of the equality of nations, a denial already embodied in the Constitution of the League, and, will, therefore, tend to diminish the prestige of its work, although conducted in good faith and by able men. Just as the Permanent Court of International Justice suffers in some quarters because it is the League's court, there would be opportunity to complain that the law was the League's law.

Arguing against modification by the League, Dr. Hill declared that judicial decisions by an international tribunal, made without any basis of accepted law, imply an exercise by the Judges of the sovereign authority involved in an act of legislation, "and, therefore, cannot be forced upon any nation, or even freely accepted by it, without a renunciation of its national sovereignty."

On the other hand, said Dr. Hill, when an international tribunal undertakes to declare and apply a body of law previously agreed upon and ac-

cepted by the nations which appear before it, "the tribunal exercises a strictly judicial authority based upon a law made by the nations under judgment."

He sketched the rules and doctrines now existing under the name of international law, and spoke of the work done by the first and second Hague conferences. The war, he pointed out, prevented the convocation of a third Hague conference.

"It should not be overlooked that the Hague conferences were designed to be, and were, in no respect military or political in their character, but wholly and solely judicial," he said. "That is what is contemplated now—a conference devoid of politics and devoid of militarism—wholly judicial."

In the peace settlement following the war, Dr. Hall said, the judicial idea was not repudiated, but it was subordinated.

"So far as it was retained," he said, "it was made to conform to the exigencies of the military and political groundwork of the world alliances aimed at in the organization of the League of Nations."

Dr. Hill insisted that, as the League of Nations is now organized, it is representative only of a group of powers, and asserted that the League was not qualified for the creation, revision or extension of international law, "which is the affair of all nations, and not to be controlled by any single group of powers."

Dr. Hill suggested that the determination of the time for a conference such as is proposed by the Tinkham resolution, should be left to the President and his advisers.

He concluded with this statement:

It is highly probable that the United States will never regard as binding upon itself any rule of action resolved upon by any group of nations, however large, which has not received its reasoned consideration and its free consent as a rule of international law, and, if this is a just prerogative of the United States, it points toward a general conference as a proper and necessary source of authority for changes and extensions in the law of nations.

The Value of the Submarine in Naval Warfare

(See Page 835, May, 1926, PROCEEDINGS.)

New York Times, 24 May, 1926.—Editorial, "The Submarine's Future."—In the new naval disarmament conference the question of abolishing submarines may be raised by Great Britain again. At the Washington Conference she had a measure of success in opposing the submarine. It was decided that "a merchant vessel must not be destroyed unless the crew and passengers have been first placed in safety," and that no attack on such a ship should be made except after refusal to submit to visit and search. The signatory Powers also condemned as an act of piracy the seizure and destruction of merchant ships when the humane rules of warfare were violated. The "practical impossibility of using submarines as commerce destroyers" was recognized. Other nations were invited to adhere to the agree-

ment entered into by the United States, the British Empire, France, Italy, and Japan.

In the UNITED STATES NAVAL INSTITUTE PROCEEDINGS for May is an article about the value of the submarine in warfare by Admiral Spindler of the German Navy. He had charge of the construction of submarines during the great war. The translation is by Commander W. P. Beehler, United States Navy, retired. It seems that before the outbreak of war in 1914 Germany had no plan of using submarines against an enemy's commerce, nor was her submarine force out of proportion to other units of the fleet. The submarine was regarded as one of the numerous auxiliaries in naval warfare. But when three English cruisers were sunk by the *U-9* in September, 1914, "without the slightest counter-offensive," the type was added rapidly to the service. No less than 343 boats were placed in commission during the war. Germany drew on her large reserve of officers and men for crews. The number of German submarines destroyed was 166, of which thirty-seven were sunk by mines and thirty-three by depth charges. "Of the many defensive measures," says Admiral Spindler, "the very excellent development of the English convoy system for merchantmen proved an exceedingly great obstacle for the German submarine." Many were the U-boats sent to the bottom by convoying warships. Strategically the Germans waged their submarine warfare at a disadvantage, for it was easy to blockade "the German Bight, located in a small angle of the North Sea," with mine fields. Then the narrow Dover Channel could be well protected, and "the stretch of water between Norway and Scotland" was almost closed by mine fields with the valuable cooperation of the United States Navy. Great Britain's anti-submarine forces included 65,000 men required for service on armed merchant vessels, 25,000 needed on auxiliary craft, and so many used for the manning, overhaul, supply and replacement of patrol vessels and in the shipbuilding yards that the German writer calculates that several hundred thousand men had to be withheld from the land operations in France. He says:

> The possibility of success and the vulnerability of England have been proven. As long as submarines exist they will continue to be a threat to those nations which are unconditionally forced to rely upon overseas transportation.

The military value of submarines is said not to have been thoroughly tested during the war. Admiral Jellicoe admits in his book, *The Grand Fleet*, that war vessels unscreened by destroyers were always in danger from submarine attack. He lost the fast cruisers *Nottingham* and *Falmouth* when the German high seas fleet steamed out toward Sunderland on August 19, 1916. Admiral Spindler's list of British warships sunk by submarines during the war is impressive. That all sea powers believe the type is formidable the building of submarine cruisers indicates. Some are so large that they could find room for the crews of merchant ships overhauled and sunk. With increase of surface speed assured the new submarines could accompany a fleet and be more formidable than ever.

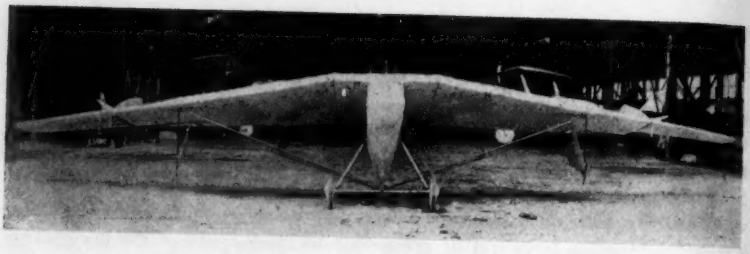


FIG. 1

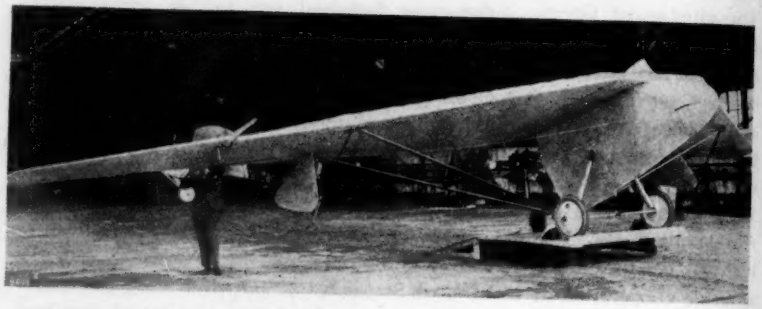


FIG. 2

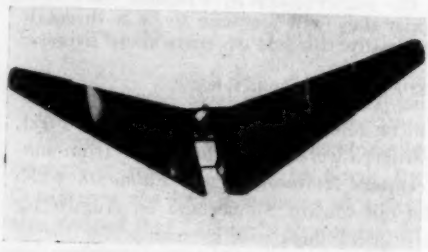


FIG. 3

FIG. 4

THE HILL TAILLESS AEROPLANE
(See page 1425)

PROFESSIONAL NOTES

PREPARED BY

LIEUTENANT COMMANDER H. W. UNDERWOOD, U. S. NAVY

FROM MAY 3 TO JUNE 3

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GREAT BRITAIN

Britain Placates Chinese Sentiment

By Thomas F. Millard, *New York Times*, 24 May, 1926.—Shanghai, May 2.—Observers of political trend in China who can detach their minds from immediate events can not but be impressed by the reorientation that is taking place. Not only are the governments of all the so-called principal powers fitfully altering their concepts and attitudes regarding China, and in turn Chinese are changing their conceptions of them, but the new orientation determines itself in terms of continents and civilizations—of Europe and Asia and America.

The Pacific Ocean era so vividly foreseen by William H. Seward, later visualized so accurately by John Hay, and then declared to have begun by Theodore Roosevelt, is taking form. The reorientation of international polity that we observe here is merely the effort of those powers which are factors in developing this new era (or think they are) to adapt their policies to existing and forthcoming conditions.

As things stand the British position and policy in China seem to be confronted by the greater embarrassments and irritations. These are a disability which Great Britain incurred by her previous political action and commercial success here. They are penalties of a "premier position" in the foreign trade and industrial development of China.

The foregoing comes to mind, partly, because at the moment the British are making a conciliatory gesture which, it is hoped, will moderate the prevailing anti-British phychosis of Lord Willingdon, a gentleman of extremely agreeable personality, is visiting China. Its purpose is to decide (or recommend) how to use the remainder of the "Boxer" indemnity due to Great Britain, and which now is to be given to China. The British Government invited several Chinese to cooperate with the commission in making a decision.

For some weeks now the joint British and Chinese commission has been traveling about China. They are well received everywhere by the Chinese and have been liberally entertained. These occasions provide opportunity for much pleasant propaganda which Lord Willingdon and his colleagues use skillfully.

On the whole an agreeable impression is created. It is not hard to give away money; even European governments will take it. Chinese and foreigners have different ideas about which is the better way to use that money, and rivalry of interests trying to participate in the allocation gives zest to the proceedings. I will not digress now to discuss the various proposals.

Viewed, however, as a political gesture I doubt if this restoration will have an appreciable effect with Chinese psychology on broad national questions. It is belated. It may be true, as asserted, that the British Government now foregoes that indemnity remainder out of generosity and from a sincere wish to help China. But it is difficult to give it that complexion to Chinese at this time. It so obviously is a reflex of a similar action of the American Government many years ago, and of other political expediencies. It was not conceived as a palliative to the events of the last year in China, because the intention of the British Government to do it was announced before these events; but Chinese connect the two things mentally, and it will be hard, if it ever is possible, to dissociate them.

Moreover, a policy of restitution, once begun, may be hard to stop.

Which leads to the Hongkong-Canton embroglio, at the moment the outstanding irritation of Anglo-Chinese relations. And it is apt to remain an outstanding issue for a long time.

That is a peculiar situation. On the surface it appears to originate with and flow from the incident of June 23 last, when there was an armed

collision between Chinese and foreigners at Canton that resulted in fatalities. After June 23 the Chinese in Canton, in Hongkong and in Kwangtung province declared a boycott of Hongkong and of British shipping and goods. Shameen (the British residential concessions in Canton) was boycotted and put virtually in a state of blockade. Since that fateful day Shameen has been supplied with provisions by shipments from Hongkong under escort of British warships.

The Kwangtung Government, as perhaps is known, asserts an independence of the Peking Government, and in fact it exercises independence to a large degree. Peking may issue orders to Canton, but Canton does as it pleases about obeying them. At times it denounces the Peking Government roundly. It cherishes openly a purpose to send a military expedition to break down what remains of Peking authority in the Middle Kingdom. On some issues the Canton Government is one.

Yet, on analysis, there seem to be at least three distinct governments in Kwangtung province. One is the civil administration, which is imbued, apparently, with a progressive purpose, and which advocates the extreme Nationalist program. Another is the military clique, which on the face of things cooperates with the civil administration, but which there, as elsewhere in China, really holds the whip hand.

Then there are the strikers and their "pickets," who exercise important governmental functions, and who constitute a kind of government within a government. The strikers are Chinese, who, following the incident of last June 23, left their occupations at Hongkong and with British enterprises generally "for patriotic reasons," and since then have concentrated chiefly in Canton, where they carry on a ruthless boycott and embargo of everything British. Their leaders have strong Bolshevik leanings, and affiliations of a sort have been established between them and the Third International.

The pickets are the army of the strikers which enforces their policy. The pickets now wear uniforms and have something like military organization. They intercept British goods trying to enter Kwangtung.

They intimidate Chinese who still work for Britishers. They seize cargoes which try to enter Kwangtung in British ships, and also in neutral ships. They extend powerful influence to Hongkong, where the port has been almost tied up since last June. They collect revenue by taxing communications and transportation. They make rules and regulations for the ports of Canton and Swatow regardless of treaties. Unless it is willing to pay tribute to the strike committee, commerce cannot operate in Kwangtung now.

The civil and military governments in Canton, Swatow, and elsewhere in that province do almost nothing to interfere with operations of the strike committee. It is known that popular psychology in that part of China is with the strikers, and no government, civil or military, has dared so far to suppress their activities.

Recently the strike committee interfered with the maritime customs administration in Canton, and the local customs officer (a British subject) closed the custom house. A serious crisis pended; but as that action dammed the revenue from that gabelle (which then was being held in Canton) and seemed likely to provoke united action by foreign powers, the civil government bestirred itself and somehow induced the strike committee to moderate its attitude. But the strikers remained angry, and only last week that customs officer was attacked by Chinese and roughly handled. As the other Kwangtung Governments are independent of Peking, so the strike committee is independent of the civil and military administrations at Canton. It is a law unto itself.

Yesterday the principal British press organ in China, published in Shanghai, criticized the Canton situation strongly, and protested at what

is termed the unfair treatment of an "inoffensive and unoffending" colony (Hongkong).

This treatment of Hongkong may be unfair and unjust, but to say that the colony is inoffensive and unoffending to Chinese shows an obtuseness which explains much of the present predicament of the British policy in China. The mere existence of that Colony is an offense to the new Chinese nationalism.

Imagine that a European power possessed Staten Island in New York Bay and held by lease a considerable area on the adjacent Jersey mainland, and that it also occupied Blackwell's Island as a residential concession, where the jurisdiction and laws of that foreign power obtained, and you have an analogy of the Canton-Hongkong situation. Canton is the natural (omitting Hongkong) port for Southern China, and since they learned the value of such things the Cantonese have cultivated designs to make a modern seaport there. That was one of Sun Yat-sen's dreams. He had elaborate plans for the port made and began an effort to capitalize the project. Sun accused Hongkong of blocking his project, and without doubt the colony was strongly opposed to it, for obvious reasons.

Out here the British seem to think they answer Chinese opposition to the status of Hongkong by saying, truthfully, that it is a free port, that it provides every facility to commerce that Canton could, and that it is no impediment, but rather is a help, to the development of Southern China.

Chinese retort, granting that Hongkong is the "natural" port for Southern China, that only proves that the place must be recovered by China, for no nation should or will submit to having one of its essential ports held by a foreign government. When I was in Canton once a few years ago the Chinese (and Sun Yat-sen) had in mind to develop a great port there. That idea now is giving way to the view that the real solution is to retake Hongkong from Great Britain.

(Perhaps I should say that Hongkong is an island lying close to the mainland, and the British have a leasehold of an area on the mainland called Kowloon, the enclosed water between them being the harbor of Hongkong. There is a good deal of confusion on this point in Western countries. Only a few months ago I read on the menu of an ocean liner which plies regularly to the Far East the words "Hongkong, China." I suppose many people think of Hongkong as being in China. In fact Hongkong is a British colony, the same as Bermuda and Jamaica. The island formerly belonged to China and was compulsorily ceded to Great Britain following the "Opium War." To get the relation in Chinese eyes of Hongkong to China now, imagine that Bermuda was where Staten Island is.)

Hongkong is the big grievance of Chinese nationalists against Great Britain, but by no means the only one. There are more than thirty territorial areas in China that are under foreign authority, and of them Great Britain holds eight exclusively (more than any other nation) and dominates a number of others which have an international status. In that way Britain's enterprise and success now react against her.

It has been the practice (somehow a provision to this effect was slipped into an old treaty) to allot the important position of Inspector General of Maritime Customs to the foreign nation having the largest trade with China. So, since the maritime customs was organized the position always has been held by a Britisher. Since the present anti-British feeling set in the Chinese have wanted to replace the British Inspector General and at times efforts to do that are made.

Recently the Peking Government threatened to remove Sir Francis Aglen, the Inspector General, and put a Chinese in his place. The Minister of Finance, then facing a stringency, sought a new loan by the customs surplus, and Sir Francis Aglen refused to take over the loan because in

his opinion the surplus could not carry an additional burden at the time. It is reported that the Britsh Legation supported Sir Francis Aglen with a strong protest; at any rate, he held his place, but whether because the whole government soon fell and that Minister of Finance had to quit office, or for another reason, I do not know positively. The question will revive again and again; of this one may be sure. Here again the British, by being to the fore, were "goats" of a situation and bore the brunt of action which in principle touches all foreign interests.

Probably it was inevitable that prominence of British trade in investments in China in time would cause the new Chinese nationalism to concentrate on them on the theory of striking at the largest object, which, in commerce, is liable to be more vulnerable. It explains why Chinese colleges are offering prizes for plans to apply a national boycott against British goods and industries, but, as yet, do not include other nationalities.

I have only touched a few raw places of Anglo-Chinese frictions, to indicate the deep lying issues. Other questions in which British are principally concerned, such as foreign shipping on China's interior waters, and in China's coastwise trade, are very contentious and have to be dealt with before long.

Notwithstanding their evident discomfort in these circumstances the British in China hold grimly to their position. Most of them appear to act on the idea "hold fast and the storm will pass."

Others see writing on the political sky. It is an obtuse person who cannot see that the old positions are crumbling and a place hereafter for foreigners and foreign trade in China must be built on new foundations.

The Engineering Branch of the Royal Navy

The Engineer, 30 April, 1926.—The object of this article is to place before the readers of *The Engineer* a short account of the history, development, and duties of the Engineering Branch of the Royal Navy, for since the publication of the notorious Fleet Order in November last, it has become more than ever important that the public should appreciate the importance of the position occupied by the engineers of the Royal Navy. To the layman the domestic affairs of our public services often appear complex and confusing. Especially is this the case with naval matters, where the interlocking of naval, civilian, administrative, and technical sections is of an elaborate character. The Board of Admiralty is at once the head of a great fighting service, and of a vast industrial organization. Its activities are many-sided, but while all the various branches of the purely naval service are represented at the Admiralty, many departments at the Admiralty are not represented in the fleet. The engineering branch, it is perhaps unnecessary for us to say, has important duties, not only afloat, but also ashore.

What may be called the three great technical departments of the Admiralty directly responsible for the construction, repair, upkeep and running of the ships of the fleet and their machinery are the constructive branch, the engineering branch and the electrical branch, presided over respectively by Mr. W. J. Berry, C.B., Director of Naval Construction; Engineer Vice-Admiral Sir Robert B. Nixon, K.C.B., Engineer-in-Chief of the Fleet; and Mr. McClelland, C.B., Director of Electrical Engineering. There are other departments which also deal with technical matters, such as those of the Director of Dockyards, Director of Naval Ordnance and Director of Torpedoes and Mining, the heads of which are naval executive officers, but practically all the professional technical assistants employed in them are drawn for the time from the constructive, engineering and electrical branches. These three branches are also represented by groups of officers in the home and foreign dockyards, and it is on their profes-

sional knowledge, their zeal and energy, that ship's officers are largely dependent in their efforts to maintain a high standard of efficiency throughout the fleet. But while the officers of the constructive and electrical branches are civilians, the officers of the Engineering branch are naval officers, available for duty in shore establishments or in ships.

The Engineering Branch

The engineering branch of the Navy may be said to have had its birth when the Admiralty in 1821 purchased the little *Monkey* and laid down the *Comet,* vessels of about 200 tons, fitted with engines built by the famous firm of Boulton and Watt. The great engineer himself was then dead, but when later on the navy possessed a considerable fleet of steamers, the Admiralty called to their assistance Peter Ewart, who had been an assistant and personal friend of Watt. Woolwich Dockyard was the first home of naval engineering, and Ewart took up his residence there in 1835, being then sixty-eight years of age. Two years later an office was opened in Somerset House, and Captain Sir Edward Parry, the Arctic explorer, became Comptroller of the Steam Department at the Admiralty. In 1846 he was succeeded by Captain Ellice, who a year afterwards was followed by Thomas Lloyd, by far the most important engineer connected with the branch in its early days. Born at Portsmouth in 1803, Lloyd had been trained as a naval architect, but quite early in his career had been detailed to study steam machinery, and he thus became an inspector of steam machinery at Woolwich, and from 1847 to 1869 held the office of Engineer-in-Chief at the Admiralty. His successor in the office was another civilian, Sir James Wright, but on his retirement, in 1887, Richard Sennett, a naval engineer, holding the now obsolete rank of Inspector of Machinery, was made Engineer-in-Chief. Sennett has been followed by Engineer Vice-Admirals Sir John Durston (1889-1907), Sir Henry Oram (1907-1917), Sir George Goodwin (1917-1922), and Sir Robert Dixon.

It will thus be seen that the engineering branch of the navy is not, as many appear to suppose, of recent growth. The steam vessel H.M.S. *Lightning* was employed in actual warfare in the Mediterranean in 1824; in 1833 the *Rhadamanthus* crossed the Atlantic to Barbadoes; steam sloops did good work in the Syrian campaign of 1840, and the first shots in the Crimean War were fired by steam frigates. Fighting under sail may be said to have come to an end with the action of the *Arcthusa,* under Captain Mends, against the forts of Odessa in 1854. For many years we clung to masts and yards, but for all practical purposes the knell of the wooden ship and the sailing ship as engines of war was sounded in the Russian War. From that time sailors began to be displaced by stokers, and fifty years later engineroom complements accounted for a third of the men in the navy. In 1900 there were some 970 engineer officers and 24,000 men; in 1910, 1461 officers and 37,000 men; while during the war the Engineer-in-Chief had under him a body of officers and men exceeding 80,000.

The Engineer-in-Chief

How the department of the Engineer-in-Chief at the Admiralty came into existence has already been shown, and mention has been made of the officers who have been at its head. Engineer Admiral Dixon has held office since 1922. His immediate staff comprises two groups of officers, those at the Admiralty and those serving as overseers in the various shipbuilding and engineering centers. Altogether, there are two Engineer Rear-Admirals, nine Engineer Captains and thirty-four other officers on his staff, and most of them have passed through the higher courses of training at the Royal Naval College, Greenwich. The design of new machinery, the preparation of specifications, the production, inspection, and testing of main and auxiliary machinery driven by steam, water and oil, are all dealt with

by these officers. The Engineer-in-Chief also advises on questions of large repairs, and alterations and additions to ships in commission; he is consulted by the Director of Dockyards as to the extension of workshops and machinery; fills certain duties in connection with the fleet oilers and has charge of the experimental oil fuel station at Haslar, and also of the Admiralty engineering laboratory at West Drayton, where difficult problems in connection with the machinery of submarines have been successfully solved. The wide scope of these duties will be realized by those familiar with modern developments. The cost of a fighting ship may run into some six millions of pounds sterling, and of that sum one-half to three-fifths may be due to the various machinery contracts. A battleship is an epitome of the application of scientific discovery and mechanical invention, and her engine-room is a floating super-power station.

Director of Dockyards

The engineering work done under the Director of Dockyards is only second in importance to that done under the Engineer-inChief. The history of our yards goes back to Henry VIII., but the introduction of mechanical engineering as distinct from the old mill-wrighting was due to Sir Samuel Bentham, who installed steam engines, and Brunel, whose wonderful block-making machinery marked an epoch in dockyard practice. Simon Goodrich, who trained some of the earliest naval engineers, was Mechanical Engineer of Portsmouth from 1799 to 1831. But, as already remarked, Woolwich, not Portsmouth, was the cradle of naval engineering. Ewart and Lloyd at first had their offices there, and in 1838 a steam factory was erected. About the same time Thomas Hamshaw became engineer of Malta Yard, and by 1846 there were engineering shops at Chatham, Portsmouth, and Devonport. Among the civilian officers found in them were Andrew Murray, a student of Edinburgh and an assistant of Fairbairn, and Charles Atherton, a Cambridge Wrangler and a pupil of Telford.

Naval engineering from the first was associated with many famous engineers, and it is a misconception to think that the early engineers in the navy were all men of little or no education. Just as the office of Engineer-in-Chief in 1887 was filled by a naval engineer, so the appointments at the yards had gradually ceased to be held by civilians, the much esteemed John Dinnen being the first naval engineer to hold such a post. To-day naval engineers hold all the appointments in the engineering departments at the yards, some fifty experienced officers being borne for this duty. At each yard will be found drawing and estimating offices, foundries, smitheries, boilershops and fitting and turning shops, each dockyard constituting an engineering concern comparable with the largest of industrial establishments. The principal duties of the engineer officers consist in directing the fitting of new machinery aboard ships, the repair of the machinery of ships in commission, and the general oversight of yard machinery. In carrying them out the officers are assisted by foremen, inspection and chargemen who supervise the actual work, the total number of subordinate officers and men reaching some 15,000.

Naval Ordnance and Torpedoes

Two further departments of the Admiralty which are especially dependent on their engineering staffs are those of the Director of Naval Ordnance and Director of Torpedoes and Mining. It was in 1869 that chief engineers afloat were first directed to inspect iron gun mountings, and if necessary to repair them, and a few years later care of the steam turret gear was added to their responsibilities. Engineer officers were also appointed for the re-venting of heavy guns, and it was Edward Newman, Chief Engineer of Portsmouth Yard, who, in conjunction with Captain Grenfell, worked out one of the first designs for a hydraulic gun mounting. For

some years an engineer was borne on the staff of the Engineer-in-Chief for gun mounting work, but on the formation of the department of Naval Ordnance, engineer officers were attached to it. Their work is a specialized form of mechanical engineering, but the officers employed have a thorough knowledge of all the machinery of warships. At present they are known as Engineer Inspectors, a title which does little justice to their relative importance. At the head of the inspectors is an Engineer Admiral, who is assisted by six naval engineers at the Admiralty and thirteen others stationed at the works of Armstrong, Vickers, etc. A modern turret and its guns may weigh over 1400 tons, and the whole of the training, elevating and sighting of the guns, and the loading and transportation of ammunition is done by hydraulic machinery, for which the engineer officers are responsible. In complexity a modern gun-house rivals the main engine room, while the machinery is of a very costly character. In the dockyards the gun mounting work is also carried out by engineer officers who, in addition, take charge of spare mountings and deal with rangefinders, telescopes, instructional appliances, etc.

Just as the coming of the steam and hydraulic gun mounting called for engineering knowledge, so did the introduction of the torpedo. Whitehead invented his automobile torpedo in 1866. For over twenty years the torpedoes in ships and all the stores for them were in the charge of the engineer officers, and engineers have played a very important part in the development of this particular weapon. Torpedo work comes under the Director of Torpedoes and Mining, a torpedo specialist of great experience, but the torpedo depôts at the naval ports, the torpedo factory at Greenock and the mining depôts at Frater (Portsmouth) and Wrabness (Harwich) have from the first been in charge of engineer officers.

Other Occupations

Besides the Admiralty and dockyard departments referred to, engineer officers are employed in various other sections. An Engineer Admiral is borne on the staff of the Second Sea Lord in connection with the *personnel,* and others serve in the Naval Intelligence Division, and under the Director of Naval Equipment and the Director of Armament Supply. Officers of the engineering branch are inspectors of coal in Wales and the North, inspectors of oil in Persia, and they are found on the staff of the chemical warfare station at Porton, while an Engineer Commander is assistant *attaché* at Washington.

From this brief sketch it will be seen that many important and interesting appointments at the Admiralty, calling for the highest professional training and the widest experience, are open to officers of the engineering branch. The work in many cases is that of administration, and that there should ever have been a dearth of cadets from Dartmouth anxious to prepare themselves for these appointments can only be explained by the existence of a suspicion that the standing of an engineer was inferior to that of a torpedo officer or gunnery officer or by a feeling of uncertainty as to what the future of engineer officers was to be. With the engineering branch and its work in the fleet we deal below.

Naval Engineers and the Fleet

Having thus briefly reviewed the work of the engineering branch of the navy at the Admiralty and in the dockyards, we now turn to consider more fully first the history of the branch, and then its work in the fleet. The story of the rise of the naval engineer is, perhaps, without parallel. Though, at first, as undesired in the navy as is a girl in a Chinese family, his usefulness led him to be tolerated, but when, with the progress of invention, he became indispensable, the toleration gave way to other feelings. But whether the engineer was regarded with jealousy or with dislike, the

advance of engineering could not be stayed, the shipwright had to abandon saw and adze for shears and punch, the rigger and sailmaker gave way to the boilermaker and fitter, and ships gradually changed in character. Today, as everyone knows, a man-of-war is a product of engineering from stem to stern, its spaces are fitted wth machinery, and only those trained in engineering science and the hard school of practical mechanics, are masters of the structure and its engines.

When the naval engineer first made his appearance he was a mechanic straight from bench and forge. Millwrights, blacksmiths, whitesmiths, and such, all found their way into the early steamers, and there is no need for surprise at the traditional story that the qualifications of one were that he had made and sold gridirons at fourpence apiece, or four for a shilling. These pioneers matriculated in the same school as George Stephenson. From 1821 to 1837 they were just engine men who came and went as they chose. Of their wanderings we know little, save that the commanding officers were as perplexed as to how to retain the good ones as is a mistress to keep her maids. According to that greatest of Admiralty secretaries, John Barrow, the first official order relating to the engineers was issued in 1835, commanding officers of steamers then being enjoined to forward monthly statements as to their engines, defects, fuel, and so forth, the last clause being devoted to "the conduct of the engineers during the month."

With the advent of Captain Sir Edward Parry at the Admiralty in 1837, things underwent a great change. The engineers were made warrant officers, first, second, and third-class, records began to be kept and a system of training was inaugurated. The claim to be the oldest of naval engineers was probably allowed to Andrew Witham, whose name is the first on the Registers. Witham was born as far back as 1780. He had learned his trade at the Butterley Ironworks, which still flourish, had worked for the Duke of Portland, and for years had served in the steam packet service, then under the Admiralty. In 1837 it is recorded of Witham that he was "a very careful good engineer, quite competent to take charge of and repair engines, but having neglected his education when young is only fit for a second-class."

By 1837 there were some twenty-seven steam paddle sloops and despatch vessels in the navy, and the number was rapidly increasing. From that time onwards the story of the naval engineer is to be found in a long series of orders in council, circular letters, memoranda and bulky reports of committees. These documents illustrate the official side. Another side is presented by the various statements of grievances, petitions, pamphlets on reform, and by hundreds of articles and letters in the press. Further information can be gleaned from the books on steam engines written by naval officers. Though they were in a minority, there were many young naval officers who saw what the coming of steam meant, and prepared themselves for it. Such were Robert Otway, Spenser Robinson, Cooper Key, Williams, Gordon, and William Mends. These officers not only studied steam, but took off their coats and worked at the bench, while some of them compiled excellent textbooks on modern engineering.

The Position of Naval Engineers

To follow in detail the many changes in the recruiting, the training and the position of the naval engineers from 1837 to 1926 is impossible here, but some of the principal steps by which they have risen may be indicated. In 1841 the engineers were granted a gold band on cap and steam engine buttons on coat and collar. Next year, to stimulate them to higher things, the grant of a silver medal for "ability and good conduct" was inaugurated. But things were moving too fast for medals to satisfy, and in 1847, the year Lloyd went to the Admiralty, an order in council created the ranks

of Inspector of Machinery, Chief Engineer First, Second, and Third Class, and Assistant Engineer First, Second, and Third Class, ranking with the masters and Assistant Masters. Chief Engineers were commissioned officers, had entrance to the wardroom, and a year or two later appeared in the navy list. Some of them have left a name behind them, and the following notes should dispel the idea that the early engineers had no educational attainments. Chief Engineer Thomas Brown had been one of six boys trained as gentlemen apprentices for Naval Service in Portsmouth Yard in the '20's. With Professor Main he was the author of Brown and Main's *Marine Steam Engine*, and for years lectured on steam to naval officers at Portsmouth, where the little *Bee*, fitted with both screw and paddle was at their service. His co-apprentice, Thomas Baker, was engineer of the Queen's Yacht *Victoria and Albert*, and as such attracted the attention of the Prince Consort. Baker was the first naval engineer to become Chief Engineer of one of the home dockyards. The father of the profession of naval engineering was John Dinnen, a Portsmouth grammar school boy. An able engineer, as ready with his pen as with his wit, a fluent talker of French and Italian, sought after by Commodores and Admirals, Dinnen was a member of the Institution of Civil Engineers, and was the first naval engineer to write a technical paper. It was published in 1838. A great ornament to the service, Dinnen met his death through an accident outside the Admiralty in 1866, and now lies in Highgate Cemetery. His position among his fellows is indicated by the story that when his brother William, a far lesser man, was promoted, another officer wrote:—"Dear William, promotion cometh neither from the east nor from the west, but from thy brother John." John Dinnen was made Inspector of Machinery in 1847, and that year marked the entry into Portsmouth Yard, as an engineer boy, of Mr. Harry Williams, R.N., the only officer alive today holding the obsolete rank of Chief Inspector of Machinery.

As might be expected, the Crimean War led to a great development of the engineering branch of the navy. Of the new entrants many were undesirable and soon disappeared. A shortage of likely men led Chief Engineer George Murdoch in 1859 to tour the shops of Newcastle, Leith, and Glasgow, his recruits being known as "Murdochites." Striving for better conditions his brother officers looked on helpless, and Murdoch afterwards regretted his own success. Yet we owe the first edition of the *Steam Manual* to one of these officers recruited by Murdoch. In the '60's the engineer boys became engineer students, and some gained admission to the Royal School of Naval Architecture and Marine Engineering at South Kensington. Such well-known men as Seaton, Sennett Corner, Chilcott, Durston, Mayston, Milton, and Morcom were graduates of this school, the activities of which in 1873 were transferred to Greenwich College. The attitude towards engineers at this time however, was not very encouraging, for in two years sixty-three engineer officers were tried by court-martial against forty-five of all other ranks, some of the courts being ordered to try minor technical failures.

Engineer officers had already, in 1859, issued a pamphlet, *The Case of the Naval Engineer*. It was followed by a petition to Parliament in 1866, another pamphlet in 1867, and yet another in 1872. In 1868 the new class of petty officers, Engine Room Artificers, had been established, partly owing to the recommendation of Admiral Cooper Key, and in 1875 that distinguished officer was made chairman of a committee of two Captains and two Engineers to inquire into the best means of securing the highest mechanical skill and scientific knowledge for the engineering branch. Through the recommendation of the committee, separate messes for engineers were abolished, H.M.S. *Marlborough* was allocated as a home for engineer students, and the plans for Keyham College were laid down. The committee, moreover, brought the engineers in sight of the promised land

by recommending that they should have military status. But the conservative forces were too strong. Forty years later, military status was granted, only to be taken away again in November, 1925.

Reform

Throughout the eighties and nineties, the agitation for reform went on unceasingly; and in 1887 Fleet Engineer Quick received the thanks of the Admiralty for his "Proposed Organization of a Combatant Corps of Royal Naval Engineers." But it all seemed labor in vain, and naval engineering as a profession became vastly unpopular. Keyham College ceasing to attract, assistant engineers were entered from technical colleges and recognized workshops, but by the end of the century the position was as bad as it well could be. It was then that the late Mr. D. B. Morrison took up the matter, and the subsequent developments have been ably reviewed in the memorandum issued by the Joint Committee of the Engineering Institutions which, in January, of this year, waited upon the First Lord of the Admiralty, Right Hon. W. C. Bridgeman, to protest against the much-discussed Fleet Order No. 3241 of last November.

As the main points in connection with the introduction, the modification, the partial failure, and now the abandonment of the Selborne-Fisher scheme for common entry, common training, and equality of status are fairly well known, there is no need to dwell on them here, but it should be pointed out that the training of no other section of the navy has been subject to so many changes as the training of engineers. Many of these changes have been wholly unnecessary, they have not been brought about through the representations of engineers, and they have been very wasteful of public money. These changes, moreover, reflect the vacillating policies of successive Boards of Admiralty towards engineering matters, which have militated against the development of that *esprit de corps* which should exist in all our public services.

The Engineering Branch

The engineering branch of the navy today has a personnel of about 23,000 or 24,000 officers and men. A glance at the Navy List will show that there are some 1,300 officers of various grades ranging from the rank of Engineer Vice Admiral to that of Warrant Engineer. Owing to those changes to which reference has been made, these officers have come from many sources. Some of them entered Keyham College under the old régime; some came from technical colleges; about 250 are representatives of the new type of officer from Dartmouth College; a few have passed through Keyham after entering from the public schools; a large number are officers promoted from the ranks of the engine room artificers, and there is also a group of officers who have risen from the stokers' mess deck through the grade of Mechanician. The Engineering *personnel* as a whole is made up of some 1,300 officers, 4,000 artificers, and 18,000 stoker ratings. When coal burning was general, engine room complements had to be bigger than they are today when oil is being burnt, and in some vessels the engine room complements exceeded in numbers all the rest of the ship's company.

Officers and men of the engineering branch are employed wherever the white ensign flies. In all the home ports and in the various fleets there are larger contingents, while artificers and stokers are found on the rivers of China and other out-of-the-way places. Perhaps the largest section of the engineering branch today is stationed in the Mediterranean. There the fleet recently included eight battleships, ten cruisers, four flotilla leaders, thirty-four destroyers and six submarines, together with an aircraft carrier, a repair shop, depôt ships, sloops, mine-sweepers, trawlers, and so forth. The horse power of each battleship of the *Queen Elizabeth* class is 75,000, that of the *Iron Duke* class 29,000, the cruisers and flotilla leaders have

engines of 40,000 horse power; while the destroyers are of 27,000-30,000 horse power. Taking the whole fleet with its auxiliaries, the aggregate horse power is something like 2,000,000, and if the whole fleet were to steam full speed for twenty-four hours, it would consume over 20,000 tons of oil fuel.

The "source and magazine" of all power in a ship lies in her boilers, but her stokeholds contain not only boilers, but such things as feed pumps, oil pumps, and forced draught fans. The various engine rooms likewise house not only the steam turbines, but condensers, air pumps, electric light engines, hydraulic engines, air-compressing machinery, distilling machinery, refrigerating plant, and so on. One of the tasks of the engine room staff is to keep in order the complicated system of steam and water pipes running throughout a ship. Then, too, there are the water tight doors and innumerable fittings for ventilating, pumping and draining to be maintained in good order. It is one of the first duties of an engineer officer to make himself thoroughly acquainted with the structure of the ship and its many water-tight compartments, and to learn how they can be flooded or drained in an emergency.

The care and maintenance of the great mass of machinery in a warship calls for a large and competent staff. A battleship carries some eight or nine engineer officers, a cruiser four or five, and the destroyers and submarines one each. There are about four times as many artificers and twenty times as many stokers. Altogether, the squadrons of the Mediterranean require about 200 engineer officers, 800 artificers, and 4,000 stokers. At sea, the staff of a ship is divided into three watches, each watch doing four hours' duty out of every twelve. Steaming under way, however, is but the test of the work done in harbor. When in port there are periodical surveys, inspections and tests to be made, defects large and small have to be made good, and there is always work and to spare. Each division of the fleet has its Squadron Engineer Officer, who is on the staff of the Admiral, but each Engineer Commander is supreme in his own engine room, and is directly responsible to the Captain of his ship for the efficiency of his department. The second engineer officer in a ship is always known as "the Senior Engineer," and it is upon his shoulders that the direct oversight of the manifold activities of the engine room falls. The other officers keep watch at sea and are responsible for certain sections of the ship's machinery in harbor. To run successfully the engine room department of a battleship demands a thorough professional training and wide experience, and calls for sound judgment, readiness of resource and decision. Needless to say, another qualification is that of knowing how to handle men. Endowed with lesser powers of command than upper deck officers, the engineer has to maintain discipline, and it is a strange thing that even today an officer in charge of machinery exceeding 100,000 horse power, and perhaps 400 men, is not considered a fit person to sit on the court martial of a stoker.

It is seldom that the engine room department of a ship is brought to public notice. There have been such incidents as the patching of the boiler of the *Safieh* by Engineer Henry Benbow, "the man who mended the boiler," and the escape of the *Calliope* from the harbor of Apia during a hurricane, for which Staff-Engineer Bourke and his officers and men received the thanks of the Admiralty. But unusual pluck, heroism, presence of mind and exceptional devotion to duty in the engine room often go unnoticed. Many tributes were paid to the steaming of the fleet during the war, and, judged by any standard, the work of the engineering branch was one to be proud of. It is unfortunate for several reasons that no account of it has been published. The remarkable steaming of the *Kent*, the bringing home of the damaged *Marlborough* and *Lion*, and the exceptionally fine work of the engineering staff of the *Inflexible* when she was mined in the Dardanelles, are but four instances which would at once illustrate

the important duties of the engineering branch and the high state of efficiency maintained throughout the war. With a smaller navy and a reduced personnel, a high degree of efficiency is more essential than ever, and every effort should be made to remove every cause for discontent and to promote harmony among the various branches of the service.

FRANCE

The French Navy

The Engineer, 23 April, 1926.—The debate in the senate upon the estimates for continuing the program of naval construction revealed a sudden reawakening of the French to the necessity of having a strong navy. There is no secrecy about the influences that have brought about this revival of naval interest. The growing force of Italy, and recent declarations that its ancient control over the Mediterranean must be recovered, have compelled the French to review the situation in which they are placed by the possible supremacy of a rival power. The security of France is deemed to lie entirely in maintaining a perfectly safe communication with North Africa. The whole naval policy is based upon defending the Atlantic and Channel coasts mainly with submarines, torpedo boats, aircraft, and land batteries, and in providing a powerful fleet of fast cruisers, in conjunction with underwater and aircraft, to insure supremacy in the Western Mediterranean. North Africa is regarded as a continuation of the mother country, and there must be no risk of that continuity being broken in time of trouble. The French do not look upon the Italian aspirations with uneasiness, but they feel that they cannot exist in the Mediterranean in a state of inferiority, and during the debate in the senate there was a unanimous insistance upon the necessity of providing an adequate fleet. The French Navy has only recently been emerging from a period of preliminary reorganization. The old navy was obsolete after the war, and nothing had been done to replace lost and worn out vessels. For nearly eight years there had been practically no designing and construction of new ships. When, therefore, it was decided to start upon the constitution of a new navy in accordance with a new naval strategy there was found to be a deficiency in technical progress and skill. Everything had to be started over again, and the Minister of Marine affirms that, while there were some mishaps and disappointments, the results obtained with the new ships have, in many cases, exceeded expectations. Through lack of sufficient inducement, officers, in an unduly large proportion, have resigned their commissions, and there is a notable falling off in the number of aspirants entering the naval colleges, with the result that, it is declared, there is a decline in the number of officers as well as of their general average efficiency. More encouragement means a greater expenditure, and every attempt to enhance the value of the navy is met by the difficulty of providing the necessary funds. Nevertheless, the senate declared its intention of voting all the money that was required to raise the navy to the position it ought to occupy.

The existing program was the first to be put in hand in pursuance of a definite strategical plan. It is true that a beginning was made in 1912 with a naval statute which coordinated the program then agreed upon, and it is now urged that no time should be lost in adopting another statute which aims at harmonizing all the different services for naval defense, particularly in determining the command and distribution of the military and air forces for coast defense in association with the fleet. This organization, of course, exists, but it is characteristic of French methods that it should be openly discussed in parliament, and that all its details should be carefully laid down in what is practically a legal enactment. According to French ideas a statute places the whole question of naval defense on a positive basis, and insures that the program of naval construction is carried out according to

the original plan, without subsequent changes that may detroy the homogeneity of the fleet. Past history shows plainly the evil effects resulting from successive Ministers of Marine imposing personal ideas that are not always in accord with those of the Conseil Supérieur de la Marine. That history is apparently not to be repeated. Except for a slowing down of construction during the short period of one ministry the work has been pushed forward rapidly and is now being accelerated, with the result that by the end of June arrangements will almost certainly be made for putting another section of the program in hand. Already 112,000 tons of light-surface craft have been built or are under construction out of a total of 390,000 tons, and 26,000 tons of submarines out of 96,000 tons. As regards numbers, thirty-two vessels have been completed and seventy-two are under construction. An increase has already been made upon the original 60,000 tons of submarines and 360,000 tons of light-surface craft, and it is practically certain that the total tonnage will be further augmented when that step is rendered possible by the financial situation. The development will be largely in the direction of submarines, which the French regard as indispensable for home and colonial defense, and they will never accept any proposal to suppress, or even restrict, their construction. As for capital ships, they are left in abeyance pending the completion of a new navy composed of an adequate force of light, fast, and powerful cruisers. The capital ship does not come directly within the scope of the present scheme of naval defense, but the situation in the Mediterranean has involved changes that may give more importance to the capital ship in the future. Naval construction can only be developed and accelerated by a policy of concentration and of rigid economies. The senate has avowed its intention of voting all the funds that may be required, but those funds will be obviously limited for a long while to come. Meanwhile, the money available must be spent to the best advantage, and the *rapporteur*, M. Raiberti, insisted again upon the suppression of some of the arsenals, the destruction of which he decreed when he was Minister of Marine. Socialist opposition prevented that being done, but the senate agreed with M. Raiberti that the costly and practically useless arsenals must go, leaving only Toulon, Brest, and Lorient. Proposals for suppressing arsenals and giving a larger proportion of work to private shipyards, which are now suffering from the effects of a severe depression, will certainly be brought forward when credits are asked for to permit of the next instalment of the program being put in hand.

While satisfactory progress is being made with ship construction, the situation of the aircraft branch of the service is open to criticism. The coast defense with aeroplanes is well organized, but it does not come under naval control, and it is certain that seaplanes are less numerous and efficient than in some other navies. It is only recently that anything has been done with flying boats. There are at present ten squadrons of seaplanes and 214 machines, and in view of the troubles that have been experienced it is proposed to reorganize the service. To obviate failures a more rigorous system of reception has been imposed, with the result that many machines have been rejected. Aeroplane makers have so far lacked experience in seaplane construction. Official trials have proved more or less a failure, but the Under-Secretary of State for Aeronautics declares that great progress has been made recently, and that the forthcoming trials of seaplanes are likely to reveal a considerable improvement. On the whole, therefore, the French have reason to be satisfied with the results obtained by the methodical carrying out of a program which is providing them with an entirely new navy adapted to special needs, although the changed conditions in the Mediterranean may possibly necessitate some deviation from the original plan.

JAPAN

Japan and Disarmament

The Naval and Military Record, 21 April, 1926.—The Japanese are nothing if not practical. They have demonstrated this once again by the suggestion to eliminate the impracticable from all discussions at the forthcoming Geneva Conference upon disarmament. It will save an immense amount of futile debate if all the conferring nations agree to this general doctrine. The only trouble lies in the difficulty of drawing a definite line between the practicable and the impracticable when it comes to considering the great problems set by any scheme of international naval reduction. That anything approaching unanimity of opinion can be reached upon such a controversial point is too much to hope. Certain proposals which have been put forward by idealistic-minded people may be ruled out by general consent. But others are not so easily disposed of. Even within our own service, we see wide divergence of opinion upon questions of means and methods. One cult holds that a certain thing should be abolished; another that it is indispensable. If this be so in a single service, how much more is it likely to exist in many services?

In the very memorandum in which this suggestion to eliminate the impracticable is put forward Japan herself furnishes an illustration of the difficulty to which we refer. She thinks the use of poison gas in warfare is inhuman, and should be forbidden by agreement. On the other hand, she thinks the proposal to abolish the submarine is impracticable. We do not consider it impracticable, and would only too willingly fall into line with any scheme directed to this end. Here at once is a cleavage of opinion as to the definition of the word "impracticable" in this application of it. Japan bases her contention upon the fact that the submarine type has developed so remarkably, even since the Washington Conference.

Frankly, we fail to see how such a point of material detail affects the much wider question of principle. It is the abolition of underwater attack which is proposed. The method by which underwater attack is waged is of no real moment to the contention. But Japan, apparently, thinks that it is, and rules the proposal as impracticable on these grounds.

This reservation on the part of Japan suggests a wide field for thought. There is a widespread belief, be it right or wrong, that among the matters which will be put forward at the Geneva Conference will be a proposal to abandon the capital ship, at any rate in the form in which she now exists. Certain of the maritime powers have already given evidence, by their policy in not building any more capital ships since some time before the end of the war, that they regard this as a practicable proposition. France is free under the Washington Conference to lay down a capital ship forthwith. Her naval experts frequently discuss the form this vessel should take, and one suggestion is that the 35,000-ton ration should be divided into two 17,500-ton battle cruisers. The French Ministry of Marine says nothing. We may therefore assume that no idea exists of building such a ship or ships. Probably it is recognized that of herself, or of themselves as the case might be, such an addition to the French Navy would constitute nothing more than a tactical embarrassment.

Italy appears to hold a very similar view. We may reasonably assume that both of these powers would be ready to favorably consider any proposal for a radical change in the existent capital ship idea. The United States is the most uncertain factor in the case. Her views upon the matter are obscure: perhaps it would be more correct to say that they have never been authoritatively vouchsafed. Many competent judges in Great Britain and Japan have proclaimed that the abandonment of the monster battleship is perfectly practicable—so long as it is universally

agreed to. There must always be a premier fighting unit, and she will always be the biggest and most formidable type of ship in a fleet. Rivalry alone has produced the enormous and terribly costly vessels in the present-day battleship category. Is it impracticable to limit rivalry to given dimensions? This was accomplished at Washington in 1922, but only in a very qualified degree. The maximum of 35,000 tons was fixed so as to permit of the completion of certain vessels then under construction. There will be no need of such a concession at the Geneva Conference. Reduction of size in future battleships—if we choose to still so call them—need not be governed by any concessional motive. But if any one great power thinks the proposal impracticable, then impracticable, of course, it will be.

UNITED STATES

Wealth and Income of United States Analyzed

Wall Street Journal, 2 June, 1926.—The Federal Trade Commission, in response to a Senate resolution, issued a report on national wealth and income, which estimates the national wealth in 1922 at $353,000,000,000 and the national income in 1923 at $70,000,000,000. The increase in national wealth from 1912 to 1922, as measured in dollars, is reckoned in the report at about seventy-two per cent but it is stated, if allowance is made for changes in the purchasing power of the dollar, the real increase was nearer sixteen per cent as compared with about fifteen per cent increase in population.

For 1922 the report estimates that the national wealth consisted of $122,000,000,000 of land values, exclusive of improvements, or 35 per cent of the total; $108,000,000,000 is the estimate for improvements on the land, and $123,000,000,000 for moveable goods of all kinds. Of the total real estate value $230,000,000,000, about $43,000,000,000 is tax exempt, and belongs chiefly to the government, federal, state, and local. The report estimates the amount of wealth according to various uses; wealth in agriculture, for example, comprised about 18 per cent of the total, in manufacturing and mining about 14 per cent, and in railroads and other public utilities about 12 per cent. The largest share is said to be in dwellings and other goods used for personal necessities and enjoyment reckoned at more than one-fourth of the total.

The distribution of wealth among individuals is estimated on the basis of 43,000 probate records in twenty-four typical counties for 1912 to 1922, supplemented by an estimate of the average value of unprobated estates. On this basis, about 1 per cent of the number of decedents owned about 59 per cent of the estimated wealth, and 13 per cent of the number of decedents owned more than 90 per cent. The concentration of wealth, however, diminished slightly in the later years of the period covered. In countries having a city of more than 50,000 population, the average estate was larger and the concentration of wealth greater than in other countries.

Ownership of Natural Resources

As to the ownership of natural resources, the report estimates that for 1922 six companies controlled about one-third of the developed water power, eight companies, three-fourths of the unmined anthracite, thirty companies more than a third of the immediate reserves of bituminous, two companies more than one-half of the iron ore reserves, four companies nearly one-half of the copper reserves and thirty companies about one-eighth of the petroleum reserves.

In the estimates of agricultural wealth, attention is called to the agricultural depression and the recent marked decline in farm land prices, but acreage tilled and quantities of crops produced are considered, as well as money values.

The wealth of corporations is developed in the report on the basis of special statistics obtained from the Treasury Department, for which the book values show an aggregate amount of $102,000,0000,000 in 1922. Manufacturing corporations had the largest amount estimated at nearly $34,000,000,000, among which the producers of various metals and metal products were the most important. The railroad corporations had a greater amount of wealth than any other single industry and much the largest average amount per company.

The report states that the ownership of corporations, as shown by the number of shareholders, is generally widely distributed. Returns from 4,367 corporations, with a combined capital stock of more than $9,000,000,000 and an aggregate of 1,074,851 holdings of common stock, give an average holding of common stock of $6,969 and of preferred of $5,211. Excluding corporations, trustees, brokers, and all foreign holders; more than 90 per cent of the common stock was in the hands of individuals; corporations had only 1.1 per cent.

The wealth of non-profit institutions, religious, benevolent and educational, is estimated in the report at $14,500,000,000.

National Income Estimate

The discussion of national income consists of two main parts—first, an estimate of the total national income by branches of economic activity, and second, a special analysis of the income reported under the federal income tax law. The amount of income reported by the Treasury in its statistics of income for 1923 was $31,000,000,000, based on the returns of those persons required to make reports. The total amount so reported was considerably less than one-half of the estimated total income of the entire population. The population receiving or participating in the enjoyment of this income was about one-sixth of the total of the country. Three-fourths of this amount of income was reported by persons with less than $10,000 income, and less than 4 per cent by persons with an income more than $100,000.

The income reported in the income tax returns is classified into several groups, such as (1) wages and salaries, (2) business and partnership profits, (3) rents, royalties, interest and dividends, and (4) profits from the sale of real estate, stocks and bonds, etc. Of these wages and salaries are the most important for the grand total of income reported and generally constitute the bulk of income for persons having less than $10,000 a year.

The basis used for estimating the total income of the country is the total value of goods and services produced in the various branches of business as shown by census reports and other statistics. Additional data necessary for such an analysis were obtained directly by the commission. The total amount thus ascertained is divided between the amounts going as wages and salaries and the amounts going as interest, dividends, business profits, and other returns to capital and enterprise.

The total national income is estimated in the report for the years 1918 to 1923. The amount for 1923 is given as about $70,000,000,000, as already noted; the lowest amount was about $53,000,000,000, in 1921, and the highest amount was about $75,000,000,000, in 1920. These marked variations are partly due to the marked fluctuations in prices, showing changes in the value of the dollar. If dollars of more nearly equal purchasing power are taken (using a cost-of-living index with 1923 as a basis) the report states that the $70,000,000,000 income in 1923 should be compared with a $51,000,000,000 income in 1921 and $61,000,000,000 in 1920. While there was an increase in national income between 1918 and 1923, on either basis of comparison, of nearly $10,000,000,000, or about 15 per cent, there was also an increase in population of about 7 per cent, which affects the net increase in the income per capita.

Of the estimated income in 1923 of $70,000,000,000 about 42 per cent is attributed to manufacturing, mining and construction industries, nearly 14 per cent to agriculture, and about 12 per cent to merchandising.

The division of the total national income between labor and capital, before deducting any taxes payable by either of them, is given as 55 per cent in wages and salaries and 45 per cent in profits, rent, and interest, for 1923. Labor's proportion was lowest in 1918, and capital's proportion was lowest in 1921. These proportions are also shown for different branches of industry, and varied very widely. Thus, in agriculture the share going as wages is quite small, because most of the work is done by the farmer and his family, but the share of wages and salaries in the railroad business was nearly 70 per cent in 1923, and in the construction industry it was more than 90 per cent.

The amounts which labor and capital have to pay in taxes are not generally ascertainable in a form which enables a separate estimate for each of them, but taxes directly paid by incorporated business enterprises (not including the taxes payable by the bondholders, etc.) are estimated at 6.3 per cent of the total income for 1923.

The report also analyses the amount of corporation income as disclosed by the income tax returns from 1917 to 1923, which ranged from more than $10,000,000,000 profit in 1917 to only a little more than $1,000,000,000 in 1921. The rate of return of such corporation income, on the "fair value" of the outstanding corporation capital stock as computed by the Treasury, was 7.9 per cent in 1922, but varied widely among the various branches of business.

AVIATION

Model Designation of Naval Airplanes

Aviation, 17 May, 1926. Naval models of airplanes are divided into nine classes in accordance with the function to be performed. Each class is designated as follows:

Class	*Designation*
Fighting	VF
Transportation or general utility	VJ
Marine Expeditionary	VM
Training	VN
Observation	VO
Patrol	VP
Scouting	VS
Torpedo and bombing	VT
Experimental	VX

Class Designation

The letter "V" signifies a heavier-than-aircraft as "Z" signifies a lighter-than-aircraft. This letter is omitted in the designations of individual models of the various classes of airplanes, but must be employed in all official correspondence relative to classes of airplanes, naming of airplane squadrons, etc. When an airplane performs functions of more than one class, the primary function determines its class designation. Present practice is to designate airplanes by a group of letters and numbers. This consists first of a letter indicating the class, second, a number indicating the model and third, a letter indicating the manufacturer, followed by a dash and a number indicating the modification of the model.

The manufacturer's letters are:

A—Aeromarine P. & M. Co.	N—Navy Department
B—Boeing Airplane Co.	O—
C—Curtiss A. & M. Co.	P—
D—Douglas Co.	Q—
E—G. Elias and Bro.	R—
F—	S—
G—	T—
H—Huff-Daland & Co.	U—Chance Vought Corp.
I—	V—
J—	W—Wright Aero Corp.
K—	X—Cox Klemin Aircraft Corp.
L—Loening Aero. Engineering Corp.	Y—Consolidated Aircraft Corp.
M—Glenn L. Martin Co.	Z—

In the designation of the first model, the first number (1) is omitted. Thus the Boeing Company's first training plane is the NB-1. When a major alteration, not of a character to change the model, was made in the MB-1, the modified plane was the NB-2. A second modification of the first model would be the NB-3. A second training plane built by this company would be the N2B-1. Similarly the first modification of the N2B-1 would be the N2B-2, and the succeeding modifications would be the N2B-3, etc.

There follows a descriptive list of all naval airplanes on hand or under construction 1 January 1926. Asterisks indicate planes given model designations before the present system was put into effect and which do not conform to the above system.

The following abbreviations are used in the list of model designations given below:

TB—tractor biplane	(A)—air cooled engine
TM—tractor monoplane	(W)—water cooled engine
TT—tractor triplane	Conv't—convertible
PB—pusher biplane	Land—landplane
PM—pusher monoplane	Amphib—amphibian

Date—year first manufactured

Model	*Manufacturer*	*Features*	*Engines*	*Remarks*
CS-1* (VS)	Curtiss A. & M. Co., 1923	2-crew TB Conv't, 2-float	(W) Wright T-2	Similar to SC also (VT)
CS-2* (VS)	Curtiss A. & M. Co., 1924	2-crew TB Conv't 2 or 3 floats	(W) Wright T-3	Extra float—3rd can be dropped also (VT)
CS-3* (VS)	Remodeled NAF, 1925	2-crew TB Conv't, 2-float	(W) Wright T-3 geared	also (VT)
DH4B-1* (VO)	from Army, 1920	2-crew TB land	(W) Liberty	Enlarged tanks. Large wheels
DH4B-2* (VO)	Remodeled NAF, 1922	2-crew TB land	(W) Liberty	Armament removed
DT-2* (VT)	Douglas Co. NAF & LWF Dayton Wright, 1922	2-crew TB Conv't, 2-float	(W) Liberty	
DT-4* (VT)	NAF & Wright Aero. Corp., 1922	2-crew TB Conv't, 2-float	(W) Wright T-2	
DT-5* (VT)	NAF & Wright Aero. Corp., 1924	2-crew TB Conv't, 2-float	(W) Wright T-2 geared	
DT-6* (VT)	Wright Aero. Corp., 1925	Same as DT-2	(A) Wright P-1	
EM-1* (VM)	G. Elias & Co., 1921	2-crew TB Conv't, 1-float	(W) Hispano	
EM-2* (VM)	G. Elias & Co., 1922	2-crew TB Conv't, 1-float	(W) Liberty	
FB-1	Boeing Co., 1925	1-crew TB land	(W) Curtiss D-12	Similar to Army PW-9
FB-2	Boeing Co., 1925	1-crew TB land	(W) Curtiss D-12	Deck landing
FB-3	Boeing Co., 1925	1-crew TB Conv't, 2-float	(W) Packard 1A-1500	
FB-4	Boeing Co., 1925	1-crew TB Conv't, 2-float	(A) Wright P-2	
FB-5	Boeing Co., 1926	1-crew TB Conv't, 2-float	(W) Packard 2A-1500	Deck landing. Radio
F4C-1	Curtiss A. & M. Co., 1924	1-crew TB land	(A) Wright J-1	Metal TS design. By Chas. Ward Hall
F6C-1	Curtiss A. & M. Co., 1925	1-crew TB Conv't, 2-float	(W) Curtiss D-12	Similar to Army PW-8A and P-1
F6C-2	Curtiss A. & M. Co., 1925	1-crew TB Conv't, 2-float	(W) Curtiss D-12	Deck landing.
F6C-3	Curtiss A. & M. Co., 1926	1-crew TB Conv't, 2-float	(W) Curtiss D-12	Deck Landing. Radio.
F5L* (VP)	Curtiss, NAF and others, 1918	4-crew TB Boat	(W) 2-Liberty	Also scout and bomber
H-16* (VP)	Curtiss, NAF and others, 1918	4-crew TB Boat	(W) 2-Liberty	
HN-2* (VN)	Huff-Daland & Co., 1923	2-crew TB Conv't, 2-float	(A) Wright J-1	Engine change. Tail enlarged.
HO-1* (VO)	Huff-Daland & Co., 1923	2-crew TB Conv't, 2-float	(W) Wright E-2	
HS2L* (VP)	Curtiss, LWF and others, 1918	2-crew PB Boat	(W) Liberty	HSIL with extra wing panel
JN4H* (VN)	from Army. Built 1918	2-crew TB land	(W) Hispano A or 1	Lower wing ailerons only
JN6H* (VN)	from Army. Built 1919	2-crew TB land	(W) Hispano A or I	Upper and lower wing aileron
Longren* (VX)	Longren Aircraft Corp., 1924	2-crew TB land	(A) Lawrence L-4	Pressed fiber fuselage
MBT* (VT)	Glenn L. Martin Co., 1920	3-crew TB land	(W) 2-Liberty	Similar Martin bomber. Changed landing gear
MO-1* (VO)	Glenn L. Martin Co., 1923	3-crew TM Conv't, 2-float	(W) Curtiss D-12	
M2O-1* (VO)	Glenn L. Martin Co., 1923	3-crew TB Conv't, 2-float	(W) Curtiss D-12	Similar to NO-1
MS-1* (VS)	Glenn L. Martin Co., 1923	1-crew TB 2-float	(A) Lawrence L-4	Metal structure design similar to XS-1
NB-1	Boeing Co., 1925	2-crew TB Conv't, 2-float	(A) Wright J-4	Also gunnery
NB-2	Boeing Co., 1925	2-crew TB Conv't, 2-float	(W) Wright E-4	Also gunnery
NB-3	Boeing Co., 1925	2-crew TB Conv't, 2-float	(A) Wright J-4	Tail 2 ft. aft. Engine 10 in. forward

MO-1* (VO)	Glenn L. Martin Co., 1923	3-crew TM Conv't, 2-float	(W) Curtiss D-12	
M2O-1* (VO)	Glenn L. Martin Co., 1923	3-crew TB Conv't, 2-float	(W) Curtiss D-12	Similar to NO-1

MS-1* (VS)	Glenn L. Martin Co., 1923	1-crew TB 2-float	(A) Lawrence L-4	Metal structure design similar to XS-1
NB-1	Boeing Co., 1925	2-crew TB Conv't, 2-float	(A) Wright J-4	Also gunnery
NB-2	Boeing Co., 1925	2-crew TB Conv't, 2-float	(W) Wright E-4	Also gunnery
NB-3	Boeing Co., 1925	2-crew TB Conv't, 2-float	(A) Wright J-4	Tail 2 ft. aft. Engine 10 in. forward
NB-4	Boeing Co., 1925	2-crew TB Conv't, 2-float	(A) Wright J-4	Tail 3 ft. aft. Engine 26 in. forward
N9 (VN)	Burgess, Curtiss and others, 1917	2-crew TB Conv't, 1-float	(W) Hispano A or I	Primary seaplane training
NM-1* (VM)	NAF, 1925	2-crew TB Conv't, 2-float	(W) Packard 1A-1237	All metal
N2M-1	Glenn L. Martin Co., 1924	2-crew TB Conv't, 1-float	(A) Wright J-1	
N2N-1	NAF, 1923	2-crew TB 2-float	(A) Wright J-1	
NO-1* (VO)	NAF & LWF, 1924	3-crew TB Conv't, 2-float	(W) Curtiss D-12	Similar to M2O-1
NO-2* (VO)	NAF, 1924	3-crew TB Conv't, 2-float	(W) Packard 1A-1500	
NY-1	Consolidated Aircraft Corp., 1926	2-crew TB Conv't, 1-float	(A) Wright J-4A	Gunnery and Flight Training
O2B-1	Boeing Co., 1924	2-crew TB land	(W) Liberty	Army DH4 BM metal fuselage
O2B-2	NAF remodeled, 1925	2-crew TB land	(W) Liberty	Increased radius
OL-1	Loening Aero. Eng. Corp., 1925	3-crew TB Amphib-boat	(W) Invert. Packard 1A-1500	
OL-2	Loening Aero. Eng. Corp., 1925	2-crew TB Amphib-boat	(W) Invert. Liberty	Similar to COA1 Arctic flight
OL-3	Loening Aero. Eng. Corp., 1926	3-crew Amphib-boat	(W) Invert. Packard 1A-1500	Similar to OL-1 Photographic
OL-4	Loening Aero. Eng. Corp., 1926	3-crew TB Amphib-boat	(W) Invert. Liberty	Similar to OL-1 Photographic
PB-1	Boeing Co., 1925	5-crew PB-TB boat	(W) 2-Packard 1A-1500	Tandem engines
PN-7	NAF, 1923	4-crew TB Boat	(W) 2-Wright T-2	Development from F5L
PN-8	NAF, 1924	4-crew TB Boat	(W) 2-Wright T-3	Metal Hull. Development from PN-7
PN-9	NAF, 1925	5-crew TB Boat	(W) Geared 2-Packard	All metal. Extra tanks—special.
PN-10	NAF, 1926	5-crew TB Boat	(W) 2-Packard 2A-1500	Service PN-9
R2C-2* (VX)	Curtiss A. & M. Co., 1923	1-crew TB 2-float	(W) Curtiss D-12A	1924 racer. Remodeled R2C-1.
R3C-1* (VX)	Curtiss A. & M. Co., 1925	1-crew TB Conv't, 2-float	(W) Curtiss V-1400	1925 racer.
R6L* (VT)	Curtiss A. & M. Co., 1918	2-crew TB 2-float	(W) Liberty	
SC-1	Glenn L. Martin Co., 1925	3-crew TB 2-float	(W) Wright T-2 or -3	Similar to CS-1 also VS-VT
SC-2	Glenn L. Martin Co., 1925	3-crew TB 2-float	(W) Wright T-2 or -3	Deck and shipboard. Larger floats also VS-VT.
SC-6	Glenn L. Martin Co., 1925	3-crew TB 2-float	(W) Packard 1A-2500	Increased power also VS-VT.
SC-7	Wright Aero. Corp., 1926	3-crew TB 2-float	(W) geared Wright T-3	Supercharged also VS-VT.
SDW-1* (VS)	Wright Aero. Corp., 1924	3-crew TB 2-float	(W) Wright T-3	Similar DT-4 extra fuel capacity
TB-1	Boeing Co., 1926	3-crew TB Conv't, 2-float	(W) Packard 1A-2300	Deck and shipboard also VS-VT.

Mocel	*Manufacturer*	*Features*	*Engines*	*Remarks*
T2D-1	Douglas Co., 1926	3-crew TB Conv't, 2-float	(A) 2-Wright P-2	Deck and shipboard also VS-VT. Similr to Tn-1.
TG-3* (VN)	NAF, 1924	2-crew TB 1-float	Aeromarine T-6	Training and gunnery
TG-4* (VN)	NAF, 1924	2-crew TB 1-float	Aeromarine T-6	Fuel tank in float.
TG-5* (VN)	NAF, 1924	2-crew TB 1-float	(W) Wright F	
T3M-1	Glenn L. Martin & Co., 1926	3-crew TB Conv't, 2-float	(W) Wright T3B	Shipboard Development from SC-2 also VS-VT
TN-1	NAF, 1926	3-crew TB Conv't, 2-float	(A) 2-Wright P-2	Deck and Shipboard Similar to T2D-1 also VS-VT
TS-1* (VF)	Curtiss S. & M. Co., NAF, 1922	1-crew TB Conv't, 2-float	(A) Wright J-1	
TS-3*	NAF, 1923	1-crew TB Conv't, 2-float	(W) Wright E-2	
TW-3* (VN)	Dayton-Wright, 1922	2-crew TB Conv't, 1-float	(W) Wright E-2	
UO-1* (VO)	Chance Vought Corp., 1922	2-crew TB Conv't, 1-float	(A) Wright J-1, 2 or 3	Shipboard fixed gun
UO-2* (VO)	NAF remodeled, 1925	2-crew TB Conv't, 1-float	(W) Wright E-3 or 4	
UO-3* (VO)	Chance Vought Corp., 1926	1-crew TB Conv't 1-float	(W) Wright J-4 or 5	Training fighter Conv't to UO-1
VE-7* (VN)	Chance Vought Corp., 1920	2-crew TB land	(W) Wright E-2	
VE-7H* (VN)	Chance Vought Corp., 1921	2-crew TB, 1-float	(W) Wright E-2	
VE7SF* (VF)	Chance Vought Corp., 1921	1-crew TB land	(W) Wright E-2	
VE-9* (VO)	Chance Vought Corp., 1922	2-crew TB Conv't, 1-float	(W) Wright E-3 or 4	Flotation gear. Similar to VE-7. Hinged top cowling between seats.
WP-1* (VF)	Wright Aero. Corp., 1923	2-crew TM Land	(W) Wright H-3	Wright "Falcon". All metal. Similar to Dornier "Falke".
XS-1* (VS)	Cox Klemin Aircraft Corp., 1923	1-crew TB, 2-float	(W) Lawrence L-4	Similar to MS. Wood structure.
XS-2* (VS)	NAF, 1926	1-crew TB, 2-float	(A) Kinney 5RA	Rapid assembly

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The Influence of Aviation upon Coast Defense

The Coast Artillery Journal, May, 1926.—By Major William T. Carpenter.—The functions of fleets, fortifications, and aviation and their relations to each other in coast defense have unfortunately been confused in the public mind through the controversies waged largely by enthusiastic partisans of aviation during recent years. This is leading to jealousies and estrangements where a whole-hearted cooperation is essential.

History is again repeating itself, and the Navy is once more forced to defend the position of the battleship. First it had the torpedo boat which was to doom the battleship, then the destroyer and submarine, and now the partisans of aviation claim that aircraft has doomed the battleship and relegated the guns of our harbor defenses, including antiaircraft artillery, to the scrap heap.

Though the public mind, untrained as it is in military and naval matters, may be confused in regard to the true status of aviation, it is believed, however, that the thinking people of our country will always realize that, for national defense, we should have all types of ships, guns, aviation, and other means of defense possessed by the leading nations of the world.

The life of a maritime nation, such as ours depends upon land and sea forces for national defense. Each of these forces has a special function in the common mission of defeating the enemy during war. Their funtions separate more or less along the seacoast and become more clearly defined as their activities extend away from the shore line. Each is vitally interested in aviation since it can operate over both land and sea.

The influence of the sea has entered largely into the life and history of all great nations past and present. Through sea power maritime nations rise or fall, and without free access to the sea no peoples can obtain or hold their share of the fruits of civilization.

Our civilization has conquered the dangers of the sea, and the ocean-borne commerce of the world waits neither the whims nor variants of wind or tide. The protection of this commerce at sea depends upon the capital ship of the Navy, which, through its own self, possesses power to dominate the elements and can keep at sea for long periods during all conditions of weather.

The world is now confronted with the possibilities of aviation, and the question of the freedom of the air, with its many complications for bordering nations, now ranks second to the old problem of the "freedom of the sea." Already it has its commercial and military aspects. Aviation will not, however, reach a stage of independence in relative importance as a means of transport until it conquers the perils of the air to the same extent that marine shipping has overcome the perils of the sea.

The vulnerability of aircraft to weather has been most strikingly brought out by the various investigations of the past year. The partisans of an independent air force have contended that only experienced aviator-meteorologists are competent to order flights of aircraft and their testimony along this line indicates that aviation is not, as yet, an every day, every hour utility, adaptable to the constant and mobile demands of either commerce or war. Therefore, aviation must, through force of Nature, remain for some time to come an auxiliary means of defense.

The various trans-oceanic flights of airplanes, including the round-the-world flight, were greatly assisted and were made possible by naval cooperation. They have demonstrated that, in so far as the present is concerned, the United States is not liable to serious aerial attack from any trans-oceanic power who will not have command of the sea in war time.

There is, perhaps, no arm of the military service, other than the air service, that is better fitted to understand the powers or limitations of

aviation than is the coast artillery. There is perhaps no branch of the service that has a greater feeling of admiration for the airman and no branch that feels the need for cooperation with the air service more than does the coast artillery which manned the heavy long-range artillery and the antiaircraft artillery in France. This branch knows full well the advantage of aerial observation of artillery fire. It fully realizes the destructive effect of heavy aerial bombs upon warships and land targets. It also knows that it is not an easy matter to bring down an airplane with the present types of antiaircraft guns and equipment. The coast artillery and the air service have a common mission in coast defense, and they should work and train together for their mutual development and efficiency. There is no time to be lost in debate as to whether one supplanted or will supplant the other in coast defense.

Both artillery and aviation weapons have their limitations. Both have limitations as to range, and both are limited at times by weather conditions. Both the coast artillery and the air service must understand the functions of the Navy in coast defense and must be imbued with the idea and spirit of cooperation with the Navy at all times.

In considering the influence of aviation upon coast defense, we may liken the defense of the shore line to that of a deep defensive position in land warfare in which there are two battle positions or zones, the Navy occupying the outpost area, the delaying area, and the battle area of the first battle zone. The battle fleet forms the main line of resistance of this zone. The mission of the Navy is the tactical offensive when its strength and position permits and the offensive-defensive at other times. In case of defeat it retires to the second battle zone along the seacoast held by the remainder of the naval forces and the land forces. In this second battle zone we have the fixed elements of the harbor defenses forming a series of strong points along the line of resistance.

An analysis of the situation requires some consideration of the functions of fleets, fortifications and aviation as well as the weapons of each.

The Navy in Coast Defense

Coast defense, in its limited sense, is not primarily a naval function. It is only incidental to the broad mission of a navy as the national instrument of sea power. Sea power means safety at sea for one's ships of commerce and the maintenance of maritime routes of communication and trade. As Bacon said: "He that commands the sea is at great liberty, and may take as much and as little of the war as he will. Whereas those that are strongest by land are many times nevertheless in great straits." Mahan said: ". . . . the necessity of a navy, in the restricted sense of the word, springs therefore, from the existence of a peaceful shipping," and again, ". . . . if the defense of ports, many in numbers, be attributed to the navy, experience shows that the navy will be subdivided among them to an extent that will paralyze its efficiency."

The mere protection of our shores, either by ships, armies, or aviation, against foreign aggression will not give us the freedom of the seas for our commerce. Our commercial frontiers must extend to all ports of the world. And we may safely assume that until overseas commerce is carried by aircraft that the freedom of the seas will depend, as in the past, upon strong battle fleets capable of keeping the sea under all the adverse conditions of weather that cargo carriers must endure at sea. The battleship must continue to be the mother ship of sea power. In addition to battleships, the well-balanced fleet consists of such auxiliaries as fast cruisers, destroyers, submarines, aviation, tenders, and trains.

The Navy has a secondary or local mission in coast defense. It is to control the local sea communications including the coast-wise sea lanes, keeping them open to domestic and friendly shipping, to deny them to

enemy blockading forces, and to raiding forces such as submarines, destroyers, fast cruisers, mine layers, and other types of naval vessels, and aircraft. To accomplish this the Navy employs submarines, destroyers, subchasers, mine sweepers, scouting and patroling vessels, and various types of sea-going aircraft based on shore. For this purpose such elements of the naval forces are attached to naval districts as will not impair the battle fleet in its mission at sea.

Here the Army and Navy meet on a more-or-less common ground in coast defense, and success depends upon close cooperation between the commanders of naval districts and the commanders of defense sectors, as well as between the various branches of each service.

The Army in Coast Defense

Coast defense from the Army standpoint includes such dispositions and operations of the mobile forces of the Army as may be necessary to meet and repulse attack upon any portion of the seacoast. In this the harbor defenses play a most important part, since an invading enemy would require one or most harbors with facilities suitable for the needs of ships of deep draft, such as the large ships of the fleet, supply and transport ships.

On account of their great value to the enemy it is essential that our harbors be protected by permanent fortifications capable of immediate action at all times.

Harbor defenses. The mission of harbor defenses over the sea and land areas covered by their armament is to deny the enemy possession of the position and its utilities; to prevent destruction or serious injury by bombardment of the harbor utilities; to safeguard the shipping of various types within the harbor, and to provide an area off the harbor entrance in which naval vessels and merchant shipping will be protected as far as possible against all forms of enemy attack.

The principal weapons employed are the guns of the primary and secondary armament, antiaircraft armament, and the controlled submarine mine. These require such auxiliaries as terrestrial observation stations, position-finding and fire-control equipment, listening apparatus, means of communication, machine guns, and aircraft.

Fortified harbors have great strategical value in that they increase the strength and mobility of the Navy by relieving it of the necessity for immediate defense of the coast, by assuring it of greater freedom of movement, and at the same time affording it safe bases from which to operate and upon which to retire for rest, supply, and repair.

Harbor defenses should be of such strength as to make attack by ships improbable or to require combined operations by land and sea to bring about the fall of the area defended. Their value in this respect is *enhanced* by their readiness for immediate action. Immediate readiness is obtained only by means of fixed armament, which has the advantage of firing from a permament base with excellent facilities for service, fire control, protection of personnel, ammunition, communications and accessories, all of which can be prepared leisurely in peace-time.

The one great disadvantage of fixed armament is in its immobility. Its power is limited to the range of its guns and it cannot be moved for its own protection or for the reinforcement of other positions. If not concealed it is a fairly good target for aerial attack to which it is more vulnerable than to shell fire from the sea. However, this immobility is of great moral value since fixed armament serves as an assuring and permanent protection to the locality covered, and, as Mahan said, "Permanent works, established in quiet moments on sound principles, have the advantage that they cannot be shifted under influence of panic."

The submarine mine is an important element of the fixed defenses, as no fleet will enter a waterway until its approaches have been cleared of mines. While enemy aviation will be most useful in locating mine fields and directing the operations of mine sweepers, friendly aviation will be equally as effective in their protection.

The mandates of economy at the present time limit the amount of fixed armament for harbor defense to the minimum requirements in the way of mines, guns of the most powerful types, and antiaircraft guns as a nucleus for the defense of important harbors. These are to be augmented at threatened points, or when attacked, by mobile armament, for which space and communications should be provided for in peace-time.

Fixed armament, to date, has been the most reliable and most economical form of harbor defense. The amount of it may now be reduced somewhat with railway artillery and the bomber available in quantity for its reinforcement.

The land forces will not be called upon to exert a serious effort in coast defense so long as the fleet can keep the sea in the face of the enemy fleet or can take up a strategic position along his route of approach to our shores so as to prevent his advance. Such a position involves the possession of a suitable base, either permanent or temporary, to meet the needs of our fleet.

Should we become involved in war with a coalition of naval powers able to operate strong fleets in both the Atlantic and Pacific, then the land forces must be prepared to defend one or both of our seaboards, as the battle fleet would not be divided and would from necessity confine its activities to one of the oceans until the enemy therein could be disposed of.

In the event of the defeat or isolation of our fleet the coasts would then be open to invasion and its active defense would then become necessary. An enemy ordinarily would not expose his capital ships to the fire of the long-range guns of the harbor defenses and would usually resort to landing operations at some place outside the range of fixed armament of the primary class from where he would launch his land and aerial forces in an attempt to capture a suitable harbor base by combined land, sea, and aerial operations. The final result of such an engagement would depend largely upon our strength in heavy mobile artillery and aviation.

Aviation in Coast Defense

The missions of aviation in coast defense are reconnaissance; attack of enemy aircraft operating over and off the seacoast, landing parties, and vessels; assistance in locating and tracking targets, and in observing and directing the fire of batteries; protection of the defenses by means of smoke screens, and neutralization of enemy fire.

The means and weapons employed by aviation are observation, attack, pursuit, and bombardment planes; balloons and airships; machine guns, bombs, and gas; with such auxiliaries as communication and photographic equipment.

Aviation, due to its great mobility, is both a tactical and a strategical weapon of great importance to both land and naval forces.

From its simple land missions of reconnaissance and observation of artillery fire at the beginning of the World War it grew rapidly into a distinct combat branch of the armies with specific fighting missions.

The effect upon naval warfare has been equally as great. The airplane is now not only the eyes, range finders, and spotting instruments of the fleet, but aviation has added another weapon to increase its offensive power in combat, and one which at the same time has increased the dangers besetting the fleet in war.

The powers and limitations of both land and naval forces have been seriously affected by aviation—as they usually are by all mechanical in-

ventions adapted to war. Aviation has affected the methods of war on land and sea in very much the same way, but it has not changed the underlying principles of war—one of which is the principle of unity of command. Due to its vulnerability to weather, its dependence upon safe landing fields ashore or carrier ships at sea, and its adaptation to the purposes of land and naval forces, aviation at the present time can be considered only as an auxiliary to the military and naval branches of warfare. The principles of simplicity and cooperation demand that there be no further division of our defense forces.

The advantages gained by the advent of aviation are compensated for by the disadvantages where opposing forces are of equal aerial strength. The disadvantages are felt in the need for greater mobility, concealment, and antiaircraft defense. The employment of aviation has not only complicated warfare, but has greatly increased the cost and horrors of war.

Aviation has affected both the strategy and tactics of naval warfare, and now the modern navy seeks both naval and air bases for certain forms of its operations. The protection of the airplane carriers of the fleet is a problem that will be of great concern in future naval operations and will have its effect upon the tactics of battle.

Aircraft will bring opposing fleets into contact much sooner in the future than in the past, and, due to the radius of action of aircraft, the tendency will be for naval combat to take place farther out at sea than in the past or else off the shores of neutral countries where the fleets may meet on an equality in so far as air power is concerned. No fleet will attack an enemy fleet when it is near enough to the enemy's shores to be supported by a preponderance of his aviation based on shore. A weaker fleet may safely hover along its own shores (if they be isolated by wide stretches of water) when protected by an ample air force ashore, but at the loss of sea power to its peoples, as was the case with Germany during the late war.

When opposing fleets meet in weather suitable for launching their aircraft, the first phase of battle will be a struggle between the opposing air forces. The decision in this phase will naturally go to the side which succeeds in launching the preponderance of all power at the jump-off, regardless of the amount carried by the other side. After this will come the decision between the ships on the water, in which the surviving aircraft will play an important part.

The victorious fleet will then hesitate to advance within range of the shore aviation of the enemy unless it has aerial superiority and this means the ability to launch a superior air force in time to meet and destroy the shore aviation.

With a reasonable air force, military and naval, the United States will never suffer from an ocean-borne air force. An attacking air force must be based on shore, at some point outside the continental limits of the United States, and such a base can be established in war-time only by means of a naval superiority.

Aviation and Artillery in Coast Defense

The influence of aviation upon the powers and limitations of artillery is general and is felt to no greater degree by artillery in coast defense than is the case with mobile artillery wherever employed. The net effect upon long-range armament in coast defense is mostly to the advantage of the defenses when employed against naval craft.

Before the advent of aviation the efficiency of seacoast guns depended upon and was limited by the available means for determining the position of naval targets and for directing and observing fire against them. Observation from terrestrial observing stations was the main reliance for this service, and this service was not all that was desired. Its efficiency depended upon the height of site of these stations, weather, and atmospheric

conditions affecting visibility. The maximum range of effective visibility from ground stations, depending upon the clearness of the atmosphere, varies at times from nothing to about 25,000 yards under the best of conditions.

In night operations control of fire depends upon illumination of the target. The effective illumination of ships by searchlights depends upon their location with reference to observing stations and guns as well as upon clearness of atmosphere and weather conditions. Their effectiveness varies from a few hundred yards at times to 15,000 or 20,000 yards under the best of conditions. Ships can be picked up on very dark nights with searchlights under conditions impossible for them to be seen from above.

The successful employment of aviation with coast defenses in reconnaissance and in observation of artillery fire depends largely upon radio as a means of communication with the shore. If the enemy can prevent radio communication the efficiency of aviation in these services will be greatly impaired and its value in fire control will be very little, as rapid and accurate communication between the airplane and the firing battery is required. Visual signaling will not be practicable at long range or when the plane cannot be seen from the shore.

Aviation has Increased the Powers of Coast Defenses

By reconnaissance. Aerial reconnaissance will extend to great distances off the coast, probably to a thousand miles if large airships are available. Distant reconnaissance affords prompt and reliable information by radio of the composition, strength, and activities of enemy naval forces approaching or operating off the coast. Formerly, this service depended upon information obtained by scouting vessels of the navy.

Close reconnaissance to a distance of a hundred miles is of great importance to the harbor defenses as it will give information as to the intentions of the enemy before he comes within range of the armament. As he approaches, the information furnished by aviation will permit of the identification of his vessels and the selection of the most important targets for fire, which is of great tactical advantage. Close aerial reconnaissance is a simple matter in favorable weather, since at an altitude of a mile the airman's horizon is about a hundred miles, covering an area of about thirty thousand square miles.

Captive balloons are valuable for constant observation in order to reduce the possibility of surprise, particularly by small raiding parties.

By locating and tracking enemy targets. Aviation can locate and track enemy targets at sea with fair accuracy, thereby permitting fire to be placed upon them at times when they will not be visible from terrestrial stations. This service is rendered by giving range from the guns, compass or other bearings, by the grid system, by the radio location method, or otherwise. These methods have not as yet reached their full development. Under favorable atmospheric conditions, the captive balloon, which can ascend and remain at an altitude of 4,000 feet during winds as high as thirty and thirty-five miles per hour, affords rapid and accurate observation up to a range of about 20,000 yards.

Satisfactory tracking of a target at sea and a satisfactory target practice at a moving target, with several hits at 14,000 yards, was held at San Francisco in 1920 by means of a horizontal base maintained by two captive balloons. This emergency method would be of great advantage in case of a low, shore fog or smoke screen in front of the guns and observing stations when airplanes were not available. However, this method is not so satisfactory in windy weather and will require special observing instruments for such an unsteady platform.

By observation and control of fire at naval targets. The airplane is the best means for observing fire at ships when the means ashore cannot be

employed or prove inadequate. Acoustic methods will serve within limits when the airplane and other means cannot be used.

Aviation has increased the maximum range of effective fire by day from the maximum range of effective visibility of the terrestrial stations to the limits of effective range of the guns. The work of the aerial observer is just as accurate at the full range limit of the guns and permits of their use to the limit of range when warranted. This enables the armament to be fired effectively under all conditions of weather favorable to flying when the airman can see the target and at times when visibility from the shore is prevented by haze, low fog, smoke, or otherwise. Normally, airplane observation will not be employed at ranges less than 20,000 yards when shore facilities are adequate for that range. An observation plane will be required for each battery or group of batteries firing or for each target under a concentration of fire. This might prove a heavy demand upon the Air Service under certain conditions and one that could not be fully met.

By destruction of ships and neutralization of naval fire. By means of the bomber, aviation can carry the attack upon naval ships beyond the range of seacoast guns, and, as shown by the bombing tests against battleships in recent years, naval vessels are subject to destruction by this form of attack where the attacking aviation has aerial superiority. These tests also demonstrated that, though a naval vessel may not be destroyed, its fire is undoubtedly subject to neutralization by aerial bomb and gas attacks. The success of any attack by shore aviation against a naval fleet will vary with the relative strengths of the two air forces and the ability of shore aviation to withstand the attack of the naval aviation and anti-aircraft guns long enough to get over the vessels and deliver their bombs. Without aerial superiority over the naval aviation, little can be expected in the way of destruction of enemy ships.

By illumination of naval targets at night by means of flares. The illumination of naval targets by means of flares at times when searchlight illumination is not effective is a service that aviation can render that will be of great value to the coast defenses. In this way the presence of enemy vessels and landing operations may be detected and fire brought to bear upon them in emergencies. The same results can be obtained by means of star shells fired from the guns of the defenses but this is not desirable as the volume of destructive fire of the armament would be reduced by such an employment of important elements of the defenses.

By protection of defenses by smoke screens. By means of aviation, smoke screens can be placed in front of an enemy fleet or land forces which will greatly reduce the effectiveness of his fire giving a distinct advantage to the shore defenses.

NAVAL AVIATION HAS EXTENDED THE LIMITATIONS OF COAST DEFENSES

By reconnaissance of the defenses. Reconnaissance by naval aviation affords the enemy an opportunity to locate gun positions, mine fields, fire control stations, utilities, and other important features of shore defenses and to direct his fire more intelligently at the opening of an engagement. This has increased the need for greater concealment of such shore installations.

By observation of fire. The efficiency of naval fire is greatly increased by aerial observation, resulting in greater losses to the shore defenses. This together with the danger of aerial bombing has resulted in a wider dispersion of batteries, guns, and auxiliaries. Guns are now located farther inland from the water, where the chances for concealment are improved, and more attention is now given to camouflage than was the case before the advent of aviation. Concealment and dispersion are the greatest factors in protection from naval fire and bombing from the air. This dispersion of the guns has increased the difficulties of fire control.

Aviation has greatly reduced the importance of small islands and restricted areas as sites for fortifications, since the amount of armament that may be installed on such places must be quite limited as compared to practices of the past, and again the antiaircraft defense of such places is more difficult.

By various forms of aerial attack. (1) Bombardment aviation: While the naval bomber is not as effective as the army bomber, since it is slower and carries fewer and lighter bombs, it is another element of danger to be countered. The naval bombardment aviation must operate under cover of darkness or under the protection of a force of pursuit planes superior to those of the defense. Each bomber must have two pursuit planes for protection. A fleet will carry bombers in limited quantity as compared to the bombers of army aviation that it may expect to encounter when it gets within flying radius of the shore. A fleet of twenty battleships with two modern airplane carriers would normally carry not more than fifty-six bombers. The airplane carrier of the latest type carries about seventy-two airplanes, not more than one-fourth of which are bombers. It takes one and one-half hours to launch, and the same time to land, this number of planes. So only a part of them could be in the air at one time over a harbor defense since one and one-half hours are required for the bomber to reach an altitude of 10,000 feet at which height they must fly to be reasonably safe from antiaircraft fire. They have an endurance of five hours, or five hundred miles, and a maximum radius of action of not more than two hundred miles, in view of the times of assembling each flight after launching and the delay in landing.

The bomber must fly in a straight line at constant altitude and speed for at least three-fourths of a mile before the bomb can be dropped with accuracy. When once the plane is taken under fire the pilot must react to the same by a change of direction. He must then get in position out of the danger zone of the previous course and take up a new one before he can drop his bomb effectively.

(2) Attack aviation: It is to be expected that, under favorable conditions, naval attack aviation will be employed against the artillery of harbor defenses, particularly as a preliminary to a combined land and naval attack for the purpose of taking an important harbor. This form of attack would be delivered against all elements of the defense including gun crews, fire-control stations, searchlights, and other auxiliaries. Against such form of attack it is probable that a greater number of machine guns will be required than would be available with the troops of the antiaircraft defense. If so, the shortage could be met by equipping gun batteries, groups of fire-control stations, searchlight stations, and other elements with machine guns for their local protection.

By neutralization of fire. All forms of attack by naval aviation will tend to neutralize the fire of the guns of the shore defenses, regardless of whether or not the destruction of any part of the armament is accomplished.

By smoke screens. Naval aviation may lay smoke screens in front of the fleet for protection or may place them in front of the coast defenses, including observing stations, thereby rendering the armament useless unless shore aviation is available to direct and observe the fire against naval craft.

Antiaircraft Defense

Antiaircraft defense is a joint function of local aviation and antiaircraft troops, and, with a reasonable amount of each, a harbor defense will have little to fear from an aerial attack delivered from naval vessels. A fleet would first have to establish a nearby shore base before undertaking serious bombing operations.

CONCLUSIONS

The conclusions to be drawn from the above are:

(1) That the net effect of aviation upon coast defense has been to the advantage of the defense, since aviation has increased the power of shore armament over that of naval armament.

(2) That fixed guns of the primary armament, antiaircraft artillery, and submarine mines are the most dependable means for the defense of important harbors against naval attack.

(3) That observation aircraft and balloons should be permanently assigned to the defenses of our most important harbors.

(4) That the closest relationship should be maintained between the coast artillery and the air service in all training that affects their allied interests in national defense, with a view to obtaining the maximum development of power and a complete cooperation between these branches in all their joint functions in coast defense, particularly for the further development of antiaircraft defense.

The Hill Tailless Airplane (See page 1394)

Engineering, 30 April, 1926.—Although the number of accidents occurring to airplanes in flight due to purely aerodynamic reasons is fortunately small, such as do happen usually result from loss of control while the machine is stalled. This occurs when the angle of incidence exceeds the critical value, usually about 18°, the lift at greater angles diminishing as the angle of incidence increases and the normal controls becoming ineffective. A skilled pilot can get the machine out of a stall if he has sufficient head room, but when stalling occurs near the ground especially in bumpy weather, it usually results in a serious accident, since the time and height required to carry out the maneuvers necessary for a recovery are insufficient. Several inventors, from time to time, have endeavored to get over this difficulty, and the problem has been recently tackled by Captain G. T. R. Hill, M.C., who gave a particularly interesting account of his work and the results he has obtained, in a paper read before the Royal Aeronautical Society on the 22nd instant.

Captain Hill commenced his work some three or four years ago with the idea that the center of pressure of the wing must be stationary at all the attitudes required for a given speed range, and, to secure this, decided to employ a swept-back wing with the incidence washed out towards the tips. Movable extensions were to be provided at the wing tips for control purposes, these members functioning as ailerons and as elevators, respectively, when used independently or together. The wings were also intended to be tapered in plan mainly to reduce the chord of the controllers, but tapering also has the effect of reducing the air damping and inertia about the longitudinal axis, as well as of reducing the structure weight from the fact that there is less bending moment on the wing truss at the center. It follows from the fact that the center of pressure of the wing is stationary and coincident with the center of gravity of the machine, that the position of the controllers for trim at any angle of incidence would be along wind, and there would be no force acting on them in straight flight. Their full angular range would thus be available for control purposes even when the main wing was stalled, since the controllers would not be stalled. To steer the machine, Captain Hill decided to use vertical surfaces, which may still be called rudders, mounted below the wing surface on each side near the extremities of the fixed part.

At this stage, viz., in the spring of 1923, his proposals, which were regarded as a natural development of the earlier tailless airplanes, of which that designed by Lieutenant J. W. Dunne may be mentioned in particular, were submitted for the consideration of the Aeronautical Research Com-

mittee, but Captain Hill decided himself to construct a light airplane on the lines indicated above, in order to test out his theories under practical flying conditions. The construction of a monoplane, with semi-cantilever bracing and having a very light loading, was commenced, and during the progress of the work model experiments were carried out at the Royal Aircraft Establishment, at the instance of the Aeronautical Research Committee. Certain modifications to the original design were made as a result of these experiments, and the machine was eventually completed and tried, first as a glider, in December, 1924. Although carried out under unfavorable weather conditions, the gliding trials were considered satisfactory, and, with further assistance from the Air Ministry, a body was fitted, and a Bristol Cherub engine installed.

The machine, as finally completed, is illustrated in Figs. 1 to 4. The details of its design, which we propose briefly to describe, are most clearly shown in Figs. 1 and 2, the former being a full front view and the latter a part side view. The two remaining illustrations show the machine in flight, and, of these, Fig. 3, which was taken with the machine almost overhead, illustrates the plan form of the wings most clearly. Fig. 4 is a side view of the machine flying at a considerable angle of incidence. The area of the main plane is 223 sq. ft., and the overall span is 45 ft., while that of the fixed part only is 30. ft. The section used is based on that known as Airscrew 4, described in Reports and Memoranda No. 322, but, as a result of the model tests, the trailing edge was deflexed upwards at all points by 0.015 chord, and the top camber was reduced somewhat towards the wing tips. The sweep back of the leading edge of the main plane is 31° and that of the trailing edge 14°. The wash out of incidence is 3° at the strut attachment, increasing by a further 3° to the tip, and there is no dihedral angle. The controllers, which have an area of 55 sq. ft., are of the T.P. 3 section, except near the extreme tips, which are reduced to thin edges, and lead balance weights, visible in Figs. 1 and 2, are fitted on arms projecting forwards to secure a static balance. A variable gear ratio is employed between the pilot's control stick and the controllers, to give a low ratio when flying at high speeds and vice versa. A spring trimming device is also fitted to give any desired force on the control stick within the range + 15 lb. or — 15 lb., this device replacing the usual tail-adjusting gear.

An air brake is formed by the operation of both rudders simultaneously, and this serves to give a gliding angle twice as steep as the normal. When both rudders are in use as an air brake, however, rudder control can still be obtained. The rudders, which are 13 sq. ft. in area, are operated by a rudder bar of the usual type, but a special handle is provided for controlling their use as an air brake. Other levers are used for operating the trimming gear and the ground brake, the latter acting on the rear wheel of the undercarriage. The two front wheels of the latter are mounted on a common axle, and two legs pass up from this through holes to the inside of the body, where they are anchored by shock-absorber cords. At the rear of the undercarriage is a single metal wheel mounted in a fork, which is connected to the rudder bar for steering the machine on the ground. A locking device is also fitted to the wheel so that it can be used as a brake in landing, as previously stated. It may be mentioned that about one-third of the weight of the machine is carried on this wheel, as compared with about one-sixth of the weight carried by the tail skid of an ordinary airplane; the arrangement thus quickly brings the machine to rest after landing. The body of a tailless airplane car, of course, can be made of lighter construction than that of an ordinary machine, since, in the former, the body is not required to withstand heavy bending moments due to the tail plane and tail skid. In the Pterodactyl, as Captain Hill has called his machine, the body provides accommodation for the pilot and one passenger, and it is

built up with a special light balsam ply-wood, the weight of which is only half that of standard birch ply-wood. The engine drives a pusher screw at the after end of the body and the engine mounting consists of four steel tubes, with ball-and-socket end fittings braced with tie rods. The whole weight of the mounting is only 3½ lb., but it has been found to be quite effective in all respects.

Upwards of 20 flights have now been made with the machine, and some particulars of the results obtained will doubtless be of interest. The maximum speed of the airplane near the ground has been accurately determined as 70 m.p.h. with a total load of 658 lb., the wing loading then amounting to 2.95 lb. per square foot, and the horse-power loading to 20 lb. The minimum speed, as measured by the air-speed indicator, was between 24 m.p.h. and 25 m.p.h., but an addition of about 4½ m.p.h. to this reading was found by wind channel tests to be necessary, bringing the actual minimum speed to about 29 m.p.h. This latter figure compares reasonably with the figure of 31½ m.p.h. as calculated from the maximum lift coefficient measured on the model. By adjusting the spring trimming gear, the machine could be flown without touching the control stick at any speed, and was also found to be stable, both longitudinally and laterally, throughout its whole speed range. Owing to its light wing loading, however, it was rather sensitive to bumps, more particularly in the fore and aft direction, and one of the least satisfactory features noted in connection with the controls operated by the stick was the excessive amount of inertia existing in the system. This defect may, however, be reduced in later designs by lowering the gear ratio between the stick and the controllers, by reducing the area of the latter, and by reducing the inertia of the balance weight. Apart from the inertia effect, the fore and aft control was sensitive, powerful, and reasonably light, and similar remarks apply to the lateral control.

No definite stalling point was found, although there was a definite minimum speed; after this speed is reached, the more the control stick is pulled back the faster will the machine sink. Under these conditions, therefore, the machine may be said to be stalled, since the angle of incidence is greater than the critical angle. Good control, however, could still be obtained even in bumps, and it has been found possible to install without diving for the purpose of gaining speed. Lateral control, when stalled, is effective, but is sluggish owing to the low air speed, and the rudder control, under the same flight conditions, is quite adequate to maintain direction and to carry out gentle turns. With regard to the air brake it may be mentioned that when this is applied, the machine slows up and the nose must be put down to maintain the speed, but owing to the inherent stability of the airplane this will occur automatically if the control stick is not touched. With the air brake on, the machine glides comparatively steeply at about 40 m.p.h., and it becomes a very simple matter to judge the approach to land. Landing is extremely easy, and the machine steers well when taxying on the ground. Some pitching is, however, experienced when running over rough ground, due to the short wheelbase, and the pilot feels this motion acutely owing to his position some distance in front of the wheels. In Captain Hill's opinion, however, there is no danger from this cause.

It still, of course, remains to be proved that the essential features incorporated in the design of Captain Hill's tailless monoplane will prove equally satisfactory when applied to a more heavily-loaded machine of the biplane type, such as could be used for air transport. There is no obvious reason why this should not be the case, and any means of rendering flying safer and more reliable are certainly worthy of careful consideration. In any case it would appear that a light machine of the type described, when the few comparatively minor drawbacks above referred to have been eliminated, would be well suited to the requirements of the private user.

Ford Air Transport Reports Favorable Year

Aviation, 3 May, 1926.—April 13 was the first anniversary of the opening of the Ford air transport which, during the year just ended, has established a remarkable record, demonstrating the practicability and efficiency of airplane transportation. In observance of the day, the daily flight to Chicago was made by the *Maiden Dearborn 1*, with Eddie Hamilton in the cockpit,— the same plane and the same pilot who inaugurated the service a year ago.

Together with the report which covers the year's operation of the air service, two important developments, each a safety factor, were announced by the Ford Motor Company. The first is the experimentation with the radio beacon by means of which flying is made virtually independent of visibility conditions. The second is the decision to standardize upon multi-engine monoplanes in the company's air service.

Ford flying began on April 13, 1925, when the all-metal airplane, *Maiden Dearborn 1*, built by the Stout Metal Airplane Company, now a division of the Ford organization, left the Ford airport at Dearborn for Chicago with 1,000 lb. of freight, cheered by Henry and Edsel Ford and a large crowd and welcomed by prominent Chicagoans at Maywood Field upon its arrival there, less than 2½ hours later. Later, a second line was established between Detroit and Cleveland and, on February 15, this year, Ford planes began carrying U. S. mail, connecting Detroit with the transcontinental air mail lines.

Over 1000 trips have been made by the Ford planes during the year, covering a distance equal to more than eight times around the world and at a rate of about 100 m.p.h. Incidentally, the *Maiden Dearborn 1*, which made the anniversary Chicago flight on April 13, 1926, has a record of 302 trips during the year, carrying 298,008 lb. of freight over 68,632 miles.

The report of the operation of the Ford Air Transport given out by the company, shows that, during the year's flying, there has not been a single accident and no one injured. Practically no changes have been made in the planes which are the same today as at the beginning.

Of the 663 trips undertaken during the year on the Chicago line, 649 were completed, showing an efficiency record of over 97 per cent. In trips to and from Chicago during the year, Ford planes covered 165,495 miles, were in the air 1791 hours, and carried 635,221 lb. of Ford express and freight in addition to U. S. mail since February 15.

An even greater degree of efficiency was established on the Cleveland route, which, however, is shorter. Of 457 trips undertaken on this line, 453 were completed, an efficiency record of a little better than 99 per cent. On the Cleveland line, the planes, since July 1, have been in the air 688 hours, have covered 57,531 miles and have, in addition to the mail, carried 409,181 lb. of freight.

During the year's operation of the Chicago lines only twenty-one scheduled trips were cancelled because of weather conditions, chief of which was poor visibility. During the same period there were eleven landings due to engine trouble such as failure of the water system, gasoline supply and ignition. Bad weather, which made it impossible for the pilot to see, resulted in twenty-eight landings because of the hazardous conditions.

On the Cleveland line since July 1, ten scheduled trips have been cancelled because of bad weather and there have been eleven landings, seven due to engine trouble and four to weather conditions.

Efforts will be devoted during the coming year to overcoming the hazards of bad weather, with attendant poor visibility, and to a reduction of engine troubles.

As a means of overcoming the weather handicap, the Ford air transport will try out the radio beacon. The operation of this instrument gives a definite course, giving constant signals by means of which the pilot knows

when he is on the course and is warned when he veers from it either to left or right.

Planes manufactured from now on by the Stout Metal Airplane division of the company will be of the multi-engine type with three air-cooled engines. These will give to the plane sufficient power to continue in flight if one engine should fail and ample power to maneuver into a safe landing even if two of the engines should fail. In this way the hazard of engine trouble will be greatly reduced.

The Ford planes are designed to carry a pay load of 1,500 lb., but at no time during the year has a capacity pay load been carried, except on the first trip to Cleveland, when parts for a complete Ford runabout were transported from Detroit to the Cleveland municipal landing field where the car was assembled. The weight of the pay load was purposely kept to around 1,000 lb. in order to give the planes a maximum load of gasoline as a safety measure in case of unexpected weather conditions.

Development of the Ford air transport during the year has included leasing of a hangar site at Cleveland, purchase of a landing field, just south of Chicago, and expansions of the Ford airport at Dearborn. A new hangar is under construction at Cleveland, plans have been completed for a hangar and service building at the new Chicago field, one of the largest hangars in America is now being erected at the Ford airport in Dearborn and construction has begun on a new manufacturing plant there for the Stout Metal Airplane Company, to replace the plant which was destroyed by fire a few months ago. The new manufacturing plant will be three times as large as the former. At present, the Stout division is housed in one of the buildings at the Dearborn Engineering Laboratory group where construction of the first three-engine plane is already under way.

During the year the personnel of Ford fliers was increased from one to eight pilots.

The Fairchild-Caminez Engine

Aviation, 24 May, 1926.—Extremely interesting tests were recently carried out at the Fairchild flying field, Farmingdale, Long Island, on the new Fairchild-Caminez engine, designed and built by the Fairchild-Caminez Engine Corporation of New York. The engine, which is a four-cylinder air-cooled radial, was fitted into an Avro 504 K type machine and the demonstrations, under the guidance of Captain Richard H. Depew, Jr., were highly successful.

The engine was originally designed and constructed at the Engineering Division at McCook Field, under the direction of Harold Caminez, who was then in charge of the engine design section, but who is now a member of the Fairchild company. The engine develops 150 hp., is air-cooled, and a cam and roller arrangement is used in place of the conventional crank shaft and connecting rods. It is a four-cylinder "X" type with a projected frontal area of 3.9 sq. ft., and, although of very sturdy construction and designed for a service life of over 500 hours, its weight is less than 360 lb.

There is a big demand for light, efficient aircraft engines in America at this time and it is planned to place this new engine in production within the next few weeks. It will sell for less than a medium-priced automobile, and will require little care in maintenance.

The inventor, Harold Caminez, first started work on the cam engine seven years ago, at Cornell, while studying mechanisms. It had appeared to him that the elimination of timing gears would be a considerable improvement. So he proceeded to produce a mechanism which would give four strokes per revolutions to coincide with the four-strike cycle that is employed in internal combustion engines.

After his first year at McCook Field, in his spare time, Mr. Caminez worked up the cam mechanism in an aircraft engine design, submitting the

design to Major Hallett, at that time chief of the Power Plant Section. Major Hallett studied the design, making some very valuable suggestions. It was decided that, before any engine of this radical nature should be built, it was better to do some experimental work; and, therefore, Mr. Caminez constructed (in his Y.M.C.A. shops) a model using the cam mechanism. This engine was tested in the laboratory at McCook Field on compressed air and ran very well considering the more or less amateur nature of the machine work.

There were a lot of faults in this first design, and, from data obtained in building the experimental model, Mr. Caminez made a new, practical design of cam engine for airplane work. This design was taken up with the Chief Engineer at McCook Field and with the Chief of the Power Plant Section and it was decided to make a test engine. The first engine at McCook Field was somewhat crude but it showed that there were very good chances that a satisfactory cam engine could be made if development were continued.

Later, Sherman M. Fairchild, president of the Fairchild Aviation Corporation, became interested in the engine and the Fairchild-Caminez Engine Corporation, division of the Fairchild Aviation Corporation, is now engaged in the manufacture of this type of power plant. The first engine, the model 447-B, rated at 150 h.p., constructed by this company was given its first ground test in May, 1925. It has been on ground test for the past eleven months and on air test for the past few weeks and no defects in the basic design of the engine have been revealed.

The Fairchild-Caminez company is now concentrating its efforts on the production of a 150 hp. air-cooled engine which will develop its rated power at 1200 r.p.m. The company's factory at Farmingdale, Long Island, has been equipped for the manufacture of these engines and for the development of a complete line of various size engines of similar construction. Preparations for the production of 150 hp. engines are now under way and the designs of engines of 80 hp., 300 hp. and 600 hp., are also in progress.

Description of the Engine

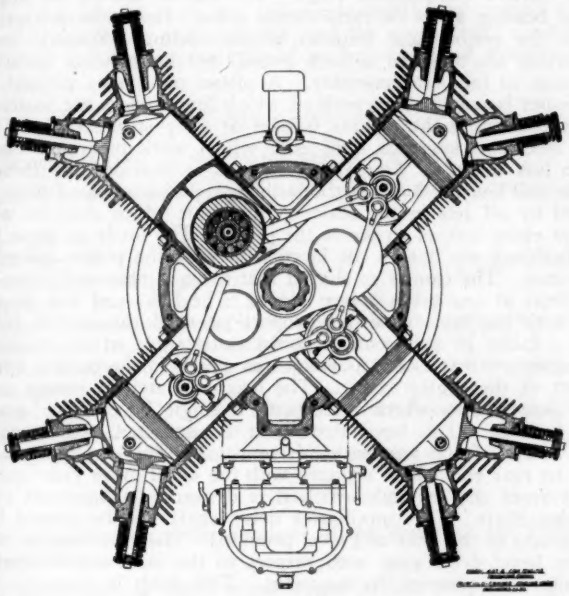
The Model 447-B engine is a four-cylinder radial engine of the reciprocating piston type operating on the four-stroke cycle. The engine employs the Fairchild Caminez drive cam mechanism in which reciprocating motion of the pistons is converted into rotary motion of the propeller shaft by means of rollers in the piston operating on a double lobed cam. The mechanism is such that each piston completes four strokes per revolution of the propeller shaft. With the four stroke cycle that is used, each piston, therefore, completes a power stroke every revolution of the shaft. It is due to this that a high power output is obtained per cubic inch of piston displacement at a low propeller speed, the shaft speed in this engine being one-half that of a crank engine of equal piston displacement for the same power output. Another important difference of this cam engine from the usual crank engine is that the motion of the pistons in opposite cylinders of the cam engine is identical with respect to the engine axis, so that the piston inertia forces balance each other. Perfect running balance is, thereby, obtained without the use of counterweights, the cam engine being the only radial or four-cylinder engine in perfect inertia balance.

In the Fairchild-Caminez engine, the four cylinders are arranged radially about a central rotatable cam as shown in Figs. 1 and 2. This cam is of the double lobed type, shaped generally like a figure 8. A roller bearing is mounted in each piston, the outer race of which acts directly upon this drive cam. Adjacent pistons are connected by a system of links, the contour of the drive cam being so designed that these links maintain the piston rollers in continual contact with the cam.

The main shaft of the engine is a straight alloy steel shaft to which the drive cam is splined. This shaft is supported in the engine case at the rear

end by a roller bearing. The front main shaft bearing is a deep groove radial ball bearing which takes all the thrust load on the shaft and part of the axial load. The center plain bearing on this shaft is fitted with large clearance so that it takes but little of the axial load and acts mainly as a means of transmitting the lubricating oil from the case to the shaft, from where it is distributed throughout the engine.

The main engine casing consists of two aluminum alloy castings which are bolted together at the plane through the cylinder axis, eight long studs being employed to hold the casing together. The front, or propeller end casting holds the valve cam followers. The engine auxiliaries, which consist of two magnetos, pressure and scavenging oil pumps, and tachometer drive, are contained in a separate casting that bolts to the rear main engine casing. The engine is mounted in the airplane by means of the rear flange on the engine casing, provisions being made for eight ⅜ in. diameter bolts.



A detail plan section drawing of the Caminez engine showing clearly the cam mechanism operating the pistons

The diameter of this mounting flange is 20 in. and the accessories behind this flange are so arranged that no connection on the engine need be disturbed when installing or removing the engine from the airplane.

Four openings are provided in the engine casing which receive the various cylinders. These cylinders consist of hardened steel finned barrels which are screwed and shrunk in special aluminum alloy heads. Bronze inserts are shrunk in the heads for valve seats. Phosphor bronze valve guides are used. The tulip shaped exhaust valve is 2¼ in. diameter, and the mushroom inlet valve is 2½ in. diameter; both valve lifts being 9/16 in. Pressed steel valve rocker brackets are bolted to the cylinder head at their rear end and attached to the engine case at the front end by a long rod, the construction being such that a firm support for these brackets is obtained without putting too much of the push rod load on the cylinder head casting. The valve rockers are alloy steel drop forgings and

have hardened steel rollers which contact on the valve stems. The push rod ball ends are contained in grease tight adjustable screws in the rocker levers, the screws providing means for obtaining proper valve tappet clearances. Provisions are made to lubricate the push rod ball ends through alemite connections in the rocker pivot bearings.

Since each piston makes four strokes per revolution in the engine, single lobed intake and exhaust cams are mounted directly on the main engine shaft which operates all the valves in the engine. The valve tappet plungers are contained in removable aluminum alloy guides which fit in the nose end of the main engine casing. Rollers are mounted on floating hardened steel pins in the end of the tappet plungers which contact with the valve cams. Small holes drilled through the main engine shaft throw jets of oil on these tappet plunger rollers for lubrication.

The pistons are made of heat treated aluminum alloy and are provided with four narrow compression rings. The pistons are of the slipper type with large bearing areas on their thrust sides. Deep ribs are provided to strengthen the pistons and improve piston cooling. Special double row roller bearings are mounted in each piston, the piston being made with detachable caps to facilitate assembly. A piston pin passes through the hub of these roller bearings at the ends of which link holders are fastened. The links inter-connecting the pistons, consist of alloy steel straps. They have hardened steel pins keyed at their ends which work in bronze bushings in the piston link holders. Ample bearing area is provided for these pins to reduce the unit bearing loads in the bushings. Lubrication of these bearings is obtained by oil jets in the main engine shaft which register with these bearings at every bottom stroke of the piston. The loads on these links and link pin bushings are due to the inertia force of the piston assembly away from the cam. The cam is so shaped that there is practically constant load on these links at any given engine speed. The links and link bearings are designed with the same generous proportions used throughout this engine and have a factor of safety of 10 at the rated speed of the engine.

The engine auxiliaries are assembled as a unit in the casting which bolts to the rear of the engine casing. The magnetos and oil pumps are driven by bevel gear pinions which mesh with a single bevel drive gear in the auxiliary housing. This bevel drive gear is connected to the main engine shaft by means of the auxiliaries drive shaft. This shaft has a straight spline on its rear end which engages with the bevel drive gear and a spiral slot at its front end through which it is driven by a hardened pin in the main engine shaft. This auxiliaries drive shaft can be moved back and forth by means of the yoke and level provided. The movement of this shaft rotates the bevel drive gear with respect to the main engine shaft and is used to retard or advance the magnetos. This shaft is normally held outward by means of a spring in which position of the shaft the magnetos are fully advanced. Pulling the shaft inward retards the magnetos. The engine starter dog also engages with the spline in the bevel drive gear, but the arrangement is such that when the starter dog comes into engagement, the magnetos are automatically retarded.

The pressure and scavenging oil pumps are of the spur gear type and are contained in a single unit which also holds the tachometer drive shaft. The oil pumps run at twice engine speed and the tachometer at half engine speed. An oil pressure relief valve is contained in the oil pump housing. The oil pressure pump draws oil from an outside tank and delivers it to a compartment containing the oil strainer through which the oil passes before it enters the engine shaft. This strainer is made so that the oil will bypass around the screen should this become clogged. The scavenging oil pump draws the oil from an oil pump made integral with the rear engine casing and delivers it to the oil tank.

The intake manifold is an aluminum casting which fits in the rear engine casing. Two separate passages are contained in this manifold which connect to the separate barrels of the Stromberg duplex carburetor through

short pipes that pass through the oil pump of the main engine casing, the carburetor being bolted directly to the case beneath the oil pump. This connection is arranged so that opposite cylinders draw from the same carburetor barrel so that maximum ramming of the induction charges together with good distribution are obtained.

The steel propeller hub is splined to the main shaft and is centered on it by a split hard bronze cone. A backing-off nut is provided in the hub so that it may be readily removed from the engine.

The detail design of the engine has been executed with the view of extreme durability and ruggedness. . . . . The comparatively low weight per horse power is obtained in the engine by virtue of the compactness of this type of engine, together with its fairly high ratio of power output to piston displacement. Ample factors of safety have been used in the design of all detail parts, liberal bearing sizes have been used throughout, and the wall thicknesses of castings and hollow steel parts have been made much greater resulting detail engine parts are sufficiently heavy and rugged to minimize distortion in machining and assembly, and the use of such construction is a major factor in lowering the cost of manufacture and maintenance of the engine.

Specifications

The general details of the engine are as follows:

Weight (complete with propeller hub and all accessories except starter) 360 lb.
Bore—5⅝ in.
Stroke—4½ in.
Piston Displacement—447 cu. in.
Compression Ratio—5.2:1 B.M.E.P. 100 lb./sq. in.
Ignition—Two four-cylinder magnetos with two spark plugs per cylinder.
Carburation—One Duplex carburetor, Stromberg NA-U-5.
Lubrication—Pressure with dry pump. Gear type pressure and scavenger pumps.
Starter—Standard U. S. Air Service starter flange provided for mounting hand or electric starter.
Bearings—Anti-friction ball and roller bearings.

Special Features of the Engine

Some especially interesting features of the design of the Caminez engine will now be discussed:

1. Development of rated horse power at low propeller r.p.m., without sacrificing high power output per unit of piston displacement.

Due to the fact that each piston of the cam engine makes four strokes per revolution instead of two as in the crank engine, the cam engine has the advantage of a geared engine without incurring the increased complication, weight, and cost of a propeller reduction gearing. Low propeller r.p.m. is thereby obtained with high power output per unit of piston displacement, which is particularly advantageous where improved airplane performance in take-off, rate of climb, and cruising radius is desired.

2. Complete balance obtained in 4-cylinder engine.

With the piston motion caused by the cam, the inertia forces in the 4-cylinder cam engine are completely balanced without the use of counterweights or any additional mechanism. This makes the cam engine the only 4-cylinder engine in perfect running balance and it is the only radial engine that does not require balance weights to effect inertia balance. The smooth running of this cam engine and the absence of vibration makes it possible to employ a 4-cylinder engine for high power outputs.

3. Adaptability for air cooling with minimum head resistance and maximum visibility.

The four-cylinder X arrangement lends itself admirably to air cooling. Moreover, the cam mechanism allows a more compact arrangement of cylinders, so that the overall diameter is considerably less than that of the conventional radial of equal power output. This small overall diameter, together with the wide gap between adjacent cylinders results in a small projected frontal area and allows good visibility. The excellent streamline shape of the main engine case and the absence of engine accessories projecting into the streamline, also reduces the head resistance. The installation of this engine requires no engine cowling and the engine will cool satisfactorily at full throttle in a 30 mile air blast.

4. Simplicity of construction and few number of parts.

Simplicity of construction is obtained with the cam mechanism as the cam and rollers are more easily manufactured and installed than the crankshaft and connecting rods which they replace. Also, due to the fact that the main shaft of the cam engine turns at one-half speed, the valve cams may be mounted directly upon it; thereby eliminating valve gears and intermediate shafting. The fact that 4 cylinders can be employed and still maintain smoothness of operation and perfect engine balance is another factor that greatly simplifies the engine by reducing the number of parts required. The simple construction, combined with the exceptionally small number of engine parts is a decided advantage both in manufacture and in maintenance, and makes possible the low production cost of a high quality aircraft engine.

5. Low weight per horsepower with sturdy detail construction

Low weight per horse power is obtained by having an engine of very compact construction, and by obtaining a reasonably high power output per unit of piston displacement. The compact construction is a feature of the cam mechanism and is obtained in the engine without any sacrifice in accessibility or reliability. The relatively small number of engine parts, combined with the compactness of the engine, allows the employment of strong, sturdy detail construction without too great an increase in weight per horse power. The wall thickness of all castings and forgings used in the cam engine are considerably larger than usually found in aircraft engines, thereby facilitating machining and preventing damage occurring in handling.

6. The use of ball and roller bearings throughout, decreasing friction, increasing reliability, and making for easy maintenance and replacement.

In the cam engine, it is extremely easy to use ball and roller bearings throughout, the difficulty of mounting such bearings as in the conventional type of crank engine being entirely absent. The employment of anti-friction bearings simplifies the manufacture and assembly, doing away with the usual scraping and fitting of bearings. Another advantage of these bearings besides the decrease in friction, is an increase in reliability, as these bearings are not effected by temporary lack or change in viscosity of the oil. The oiling system is also greatly simplified, as no direct lubrication of these bearings is required. Starting the engine in cold weather is considerably facilitated, as the congealing of oil at low temperature does not sensibly increase the effort required to rotate anti-friction bearings.

7. Accessibility and ease of maintenance.

All accessories on the engine are readily accessible and can be removed without disturbing the engine installation. The unit cylinder construction, and the employment of anti-friction bearings greatly facilitates the maintenance. The simplicity of the engine, together with the small number of parts, minimize the time required for assembly and overhaul, it being possible for two men to completely disassemble, inspect, and reassemble the engine in an eight hour day, without the use of special tools or equipment.

8. Maximum reliability and long life of engine.

The engine is constructed with ample factor of safety throughout. There are no highly stressed parts in this engine as found in the modern designs of conventional engines. Liberal sized bearings are provided throughout. The unit bearing loads on pistons and bushings are conservative. In the preliminary 50-hour test of the first experimental engine, no measurable wear was found on any of the engine parts. As it is unnecessary to resort to flimsy detail construction to obtain low weight per horse power in the cam engine, more attention can be given in design to obtain reliability and long life.

Oil Engines Will Have Plenty of Fuel

By James O. Lewis, *Compressed Air Magazine*, June, 1926.—No danger exists of a scarcity of fuel for the constantly increasing number of oil-burning engines in use in industry and transportation throughout the country, according to James O. Lewis, former Chief of the Petroleum Division of the United States Bureau of Mines and a recognized national authority on the petroleum situation.

Mr. Lewis writes, in part, as follows:

"Perhaps the situation may be summarized as follows: Supplies of cheap, 'flush' oil from new pools cannot be counted on to meet all demands for many years to come; other undeveloped sources of supply are incomparably greater than the resources from which oil has been obtained up to this time, and these latent resources should meet all our more essential needs indefinitely—among these needs being fuel oil for oil engines, and, when it becomes necessary to rely on these latent resources, higher, yet not excessively high prices may be expected for petroleum products. Higher prices at such times will, no doubt, cause many users of cheap fuel oil to revert to the use of coal or to other alternative sources of heat and power. Even so, the oil engine will have such a margin of advantage over the other users of fuel oil that it will be able to compete successfully for supplies under well-nigh every conceivable contingency.

"For some years in the recent past there was an oversupply of crude oil, caused by the discovery of new fields and the working of them faster than markets could be extended to absorb the increased production. Such periods of overproduction have alternated with periods of undersupply, and no one can foretell how these changing circumstances may succeed one another or how long each will endure. It is obvious, however, inasmuch as just so many pools will be discovered, that eventually the time must come when new pools can no longer be found fast enough to offset the decline of old wells—in short, the pools will not be able to provide for continually increasing consumption.

"Were there no other resources, the situation might be alarming; but we are coming more and more to evaluate not only the limitations in discovery of such new flush pools—with attendant cheap oil—but also the almost unlimited latent resources which, because of this low-priced oil, we have not had occasion to develop. These latent resources are numerous, and our future oil needs will be met from the sum of them rather than from any one of them. Production from new flush pools will not disappear overnight; but a time will come, possibly within the near future, when such production will reach a peak and thereafter gradually decline. The problem will then become one of filling in the gap between this declining production and the ascending demand for oil.

"What are these other resources? First of all, because in that way it will be possible quickest to meet any deficiency, it will be necessary to increase importations of oil from foreign countries—principally from South America. During the past decade explorations have gone on continuously

in Venezuela and Columbia, and fields have been discovered that should provide large supplies of petroluem when fully opened up; but, because of the greater cost of developments in foreign countries, this oil from alien sources will probably not be so cheap as oil is at present.

"Let it be emphasized at this point that we are by no means dependent or likely to be dependent upon foreign sources of supply to make up a shortage in fuel oil. We know, as a matter of fact, that but a fraction of the oil underground in any of the domestic fields is being extracted from our oil sands by the methods commonly employed—ways will be made available by which a considerable percentage of this residual oil will be recoverable. By two different processes, already devised, oil extraction has been increased in some wells from two to four times and under profitable commercial conditions, and a third process has been worked out which has proved of practical success in Europe. It has been demonstrated conclusively that the oil remaining in the sand—after mining by the usual methods—varies from three to nine times more than the oil already extracted from the pools in question. What average increase in extraction may be looked for cannot now be fixed with any certainty—in fact, the output will be determined largely by the price asked for the oil and what outlays will be warranted in recovering it; but it is clear that a tremendous increase in the yield will come from existing oil fields.

"Considered upon a potential quantitative basis, the most important latent resource of fuel oil is our oil shales. These exist in enormous measures in both the eastern and western parts of the country. Oil shale resembles a poor grade of cannel coal, and to obtain the contained oil it is necessary to mine, to crush, and to retort the shale. The quantities of oil in such shale deposits are vastly greater than the amounts of petroleum in our oil sands. Even so, the exploration of our oil shales will require an immense sum of money and involve much time to develop satisfactory extraction methods and to install equipment of sufficient capacity to supply enough oil to meet any large share of our needs.

"Oil from oil shales will be available shortly, but in relatively small quantities; and the output will gradually supplement our other sources of supply as the technique is developed which will render practicable the commercial extraction of this oil on a suitable scale. Oil from these shales will be relatively but not excessively high-priced oil.

"Other promising sources of liquid fuel are oils produced by the low-temperature distillation of coal as well as alcohols from various waste vegetable products and other sources. Some allowances must also be made for processes and sources not as yet demonstrated as commercially feasible—such as the chemical treatments of coal, etc. or the development of other power sources which seem remote today and yet may prove important factors in the life of an oil engine purchased at the present time. Any product that will replace gasoline will have its effect upon existing fuel oil because much of the gasoline now available is obtained by processing fuel oil.

"The outstanding fact, so far as it concerns the expected useful life of an oil engine bought today, is that the future supply of liquid fuel can be drawn from large and varied sources, and the utilization of these is now merely awaiting demand. In short, a serious depletion of our oil supply is inconceivable in view of the known facts and the avenues of relief which have been opened up in part and which are susceptible of nearly unlimited development."

ENGINEERING

Light Alloys or Steel?

The Engineer, 21 May, 1926.—While, on the one side, engineering developments of today call particularly for materials possessing greater strength at high temperatures, there are, in other directions, demands for materials combining great strength, at ordinary temperatures, with a minimum of weight. Such a demand comes mainly from aircraft designers, but it is likely to be made also to an increasing extent in the future in many other branches of structural engineering, more particularly where heavy masses have to be started and stopped at frequent intervals. The reduction of weight in a structure can be achieved in two ways, either by the use of heavy materials having enhanced physical properties, or by employing materials of low specific weight and of fairly good physical properties. Typical of the first type are the high-tensile alloy steels, while the light alloys of aluminium and of magnesium represent the second. Between these two types there is a certain degree of rivalry, and such rivalry frequently leads to the most important advances.

The advantages which can be claimed for each of the two types are fairly clearly defined. On the side of the alloy steels we have the fact that steel of all kinds is a material very familiar to the engineer; while the light alloys are still more or less new to him. Furthermore, the production of steels is in the hands of old-established firms of high repute and the materials thus produced naturally profit from a sense of reliability which it is difficult for newer materials to acquire. The most vital factors, however, relate to the weight-strength ratio and to resistance to corrosion. In regard to the former, the "specific tenacity" of the strongest of the heat-treated alloy steels is decidely higher than that of the best of the aluminium alloys as yet commercially available, while in resistance to corrosion the best of the rust-resisting steels or alloys of iron-nickel-chromium are undeniably superior to any light alloy. So far, the case would seem to tend overwhelmingly in favor of the alloy steels; and, in fact, a decision in their favor has actually been taken in regard to certain large airships by the Air Ministry. There is, however, a strong case for the defense of the light alloys. In the first place, there is the considerable difficulty of fully utilizing the high strength-weight ratio of the steels. Where large and light structures are concerned, weight can only be kept down by the use of exceedingly thin sections. But in the production of thin material of satisfactory quality relatively heavy costs are incurred, to which a corresponding cost in actual construction, owing to the careful handling and accurate jointing which are essential must be added. Finally, there is the difficulty in using and handling a structure built of very thin sections. Another point in favor of the weaker but much lighter material is that it allows of the use of bulkier sections and, from the point of view of rigidity and resistance to flexure in struts and columns, this is an important advantage. These, of course, are essentially questions of design and the difficulty of utilizing the high-tensile heavy materials may be readily overcome in some cases and may yet prove insuperable in others. In regard to corrosion, also, the position is rather more favorable to the light alloys than would at first sight appear. The development of processes for the protection of aluminium alloys from corrosion has now been carried so far that practical success can be claimed to a very considerable extent, both by means of electro-plating with zinc or cadmium and by means of "anodic oxidation," which is now widely entering into practice among aircraft constructors. While the invulnerability of the rust-resisting ferrous alloys is not perhaps quite reached, perfectly practicable results can be achieved, provided that the light alloys themselves are suitable and have been rightly treated.

The balance between the two types of material thus rests to a considerable extent—apart from the serious item of cost—upon the strength-weight ratio which is attainable. While it may be that even in heat-treated alloy steels large advances are still possible, there seems to be good reason to think that any early and marked progress in that direction is at least unlikely. With the light alloys, however, the position appears to be different. So far as strength-weight ratio is concerned, the original high-strength light alloy of the "duralumin" type has not as yet been seriously surpassed. Numerous efforts in that direction have been made, but so far none of the claims that have been advanced have materialized into commercial production. But it seems improbable that the very first alloy of a new type to be developed should permanently remain the best that can be achieved. It is not too much to hope, therefore, that in the near future a light alloy considerably superior to duralumin may be produced, whether as the result of work done by the industry itself, or in one or other of the research laboratories which occupy themselves with these alloys. If that can be done, the balance of the case could easily be turned decisively in favor of the light alloy, so that it is a matter which should not be neglected. The whole aluminium industry, the research institutions and laboratories, and the principal users of light structural materials—aircraft constructors primarily—are concerned with the problem. Great progress in aluminium alloys for use as castings has recently been made, largely in this country; it is to be sincerely hoped that efforts to make equally valuable progress in wrought structural materials will not be wanting, and that they will be adequately supported by those concerned with the use of such materials. Safer and lighter aircraft alone is of such immense importance that we cannot afford to neglect any possibility of progress in that direction.

RADIO

Weather Charts Broadcast by Radio to Ships at Sea

The Nautical Gazette, 15 May, 1926.—Pictures by radio are among the newest wireless phenomena, but it fell to Dr. Max Dieckmann to give them a practical application to marine service—still another step towards greater security for life and property at sea. Dr. Dieckmann's invention is a graphic radio receiving device for recording on a chart the weather reports broadcast from the observatory at Hamburg.

During her last transatlantic voyage experiments tried out by Dr. Dieckmann on board the Hamburg-American *Westphalia* were completely successful, and the inventor is now on his way to Germany by the same ship to perfect plans for making his device available for all ships.

This radio figure receiving apparatus can be attached to any radio receiving set and is extremely simple to regulate. The Munish and Nuremberg radio sending plant broadcasts daily the latest weather chart of the Bavarian National Weather Observatory immediately after it is compiled, and the Dieckmann apparatus picks it up. According to Captain Karl Graalfs, commander of the *Westphalia,* this information is reproduced by the radio figure receiver within four minutes in complete graphic form.

With such reliable data before him, any ship's officer can readily forecast weather conditions at least twenty-four hours earlier than was previously possible, says Captain Graalfs. The value of such advance knowledge can hardly be computed.

The facsimile of Radio Weather Chart shows the lines and curves and numbers giving barometric readings of Northern Europe, the Baltic, Mediterranean and Atlantic oceans. In four minutes the complete chart is developed and at any given point the probable weather can be forecast twenty-four hours earlier than by any other means known at present.

Those who have seen the device at work—it works right under your eye, in full view—are enthusiastic about it, and predict it will not be long before all ships carry one.

Associated with Dr. Dieckmann in his experiments were Rudolf Holl of the University of Munich, A. Ulfers, first radio officer, and J. Hueston, second radio officer, on board the *Westphalia*. So far the *Westphalia* is the only ship thus equipped.

One by one the perils of ocean transport disappear. Since the first wirelessed S.O.S. brought succor to the first distressed ship to signal, many thousands of lives and much valuable property have been saved and salvaged. And here we have another invention adding still further to the laurels crowning radio usefulness.

MERCHANT MARINE

Remission of Duties on Imported Materials Used in Shipbuilding

The Nautical Gazette, 22 May, 1926.—It is regrettable that Congress has decided to hold over until the next sessions consideration of the Pepper Bill, a measure designed to encourage American shipbuilding. It will be recalled that the bill provides that the government would issue bonds to shipowners building vessels in the United States for the amount of the duty that would be assessed on those parts of the ship which are constructed in this country but which otherwise would have been imported from abroad. Reduced to actual cost prices of vessels, this would mean that the capital cost of a ship built in this country would be about 30 per cent less, as it is computed that to the capital cost of a ship one-third is added for duty. In other words, a vessel whose actual construction

cost would be about $3,000,000 would cost the shipowner $4,000,000, the extra million dollars being the amount of customs duty he would have to pay on imported parts of the vessel. The Pepper Bill would relieve the shipowner of this extra million dollars. It will be seen readily that this form of aid would induce shipowners to place orders for tonnage in American yards, as the capital costs of construction in this country as compared with those abroad would be more nearly equalized, thereby creating a more active American shipbuilding industry. Other nations have been careful to aid their respective shipbuilding industries. Germany has a system of government loans for shipowners placing orders for new tonnage in German yards, France has a somewhat similar system, and Great Britain has her Trade Facilities Act under which government loans are made available for shipowners desiring to build new tonnage. The extent to which this act is taken advantage of by British shipowners can be gauged by the fact that new guaranties amounting to $20,000,000 have just been issued under it, bringing the total loans up to the end of last March to over $320,000,000. It is not difficult to understand how these loans have helped to sustain the British shipbuilding industry during the depression. In this country shipowners may take advantage of the Shipping Board's construction loan fund, but American shipowners have not been willing to avail themselves of this fund to any great extent. The Pepper Bill was very acceptable to shipowners, as it would reduce the actual cost of ships, and for this reason we regret that Congress has not acted upon the measure at this time. The tabling of this bill is significant in that it indicates that no shipping legislation will be taken up at this session of Congress, and it is now practically certain that American shipping can expect no legislative relief for at least another year.

The provisions of the Pepper Bill are not novel, as other countries have adopted a similar form of aid for shipbuilding. Italy, for example, has included in her new decree designed to protect her shipbuilding industry, a regulation providing for the remission of customs duty on imported material used in shipbuilding. Italy has gone a long way in assisting her shipbuilders and shipowners and the United States might well follow suit in some of these particulars. An Italian shipbuilding decree has been in force since February, 1923, but as this will expire very soon the Italian Government has decided upon its future action in the protection of its shipbuilding industry. A set of new regulations has been formulated and these include, in addition to the remission of customs duties, a system of construction bounties, temporary exemption from taxation for tonnage completed before a certain fixed date and additional exemptions from duties for the steel and iron industry. Italy has been giving construction bounties during the past three years, but the new bounties will be somewhat lower than those paid in the past. Furthermore, under the new regulations, these bounties will be awarded for iron, steel, and wooden ships, concrete vessels being ineligible for them in the future. The remission of duties on imported materials is not a new scheme in Italy, as this method of aiding shipbuilders has been in force for the past three years, but in the new regulations substantial additions have been made to the list of duty-free materials. The astonishing development of the shipbuilding industry in Italy during the past few years is now common knowledge, but it is not so generally known that credit for this development must be given to the 1923 decree, the direct result of which was a complete reorganization of the shipbuilding industry and a stimulus being given to the placing of orders for new tonnage in Italian yards instead of with foreign builders. The shipbuilding industry in Italy will benefit to an even greater extent as a result of the new regulations which Italian shipping interests have welcomed. In the face of the evident determination of foreign countries to aid their shipbuilding industries the apathy of our own Congress in this

direction stands out in startling contrast. Congress should follow the example of European nations in enacting laws which will help shipbuilding through the present depression, instead of tabling the very bill which was designed to aid American shipbuilders and shipowners.

MISCELLANEOUS

Modern Warfare vs. The Riffians

By Lt. Col. N. E. Margetts (*F. A.*) *G. S. C., U. S. A., Army Ordnance*, May-June, 1926.—Early in August, 1925, the Secretary of War directed that confidential orders be issued detailing a War Department General Staff Officer to proceed without delay to Paris and report to the Military Attaché for the purpose of making arrangements to get to the French Zone in Morocco to observe activities going on there, the nature of which very little was known.

Upon arrival in Paris August 22, it was found that the French War Office would not receive an American officer as official military observer, but did not object to the United States sending an officer in any other capacity.

After some delay, the representative of the Associated Press in Paris agreed to provide the observer with credentials as a war correspondent, but without obligation to write for publication as such. A visit to the Minister of Foreign Affairs resulted in receiving a personal letter addressed to Marshall Lyauty, Resident General in French Morocco, authorizing the entry of the observer into the French Zone as a war correspondent.

Investigation developed the information that all transportation accommodations by air and sea were engaged for at least ten days in advance.

The Military Attaché at Madrid was asked to obtain permission from the Spanish Government for the observer to pass through the Spanish Zone en route to the French Zone. This request was promptly granted, including an invitation for the observer to visit the Spanish Zone en route.

The observer left Paris August 26, passed via Madrid, Algeciras, Gibraltar, and arrived in Tangier August 28. Mr. Malcolm Blake, the American diplomatic agent there, arranged for the observer to visit Tetuan on the 29th in order to pay his respects to the Spanish Commander.

Tetuan is headquarters of the Spanish Army in Morocco. It is located about 80 kilometers southeast of Tangier, and is reached by auto over a good macadam road which traverses a narrow corridor strongly guarded by a series of block houses on either side and located at intervals of from 600 to 1,000 yards; each block house surrounded by wire entanglements, is connected by telephone communication with a large center. The block houses are held by a detachment of 12 to 15 men whose instructions in case of attack are to hold the post and not leave to reinforce any other attacked post.

The road to Tetuan is closed between dark and daylight, and it is reported much contraband is run over this road during the night.

Tetuan is the extreme outpost in this part of the Spanish Zone. In addition to the corridor which is kept open to maintain direct contact with Tangier, there is a macadam road and 60-cm. railroad running north to Ceuta on the Mediterranean Sea. This port is the supply base for the troops at Tetuan and in the Tangier corridor. The garrison at Tetuan consists of combat troops of all arms, and numbers about 8,000 men. The advance lines are only three or four kilometers distance and for the past year the Riffians have been firing on Tetuan with artillery, from strong positions to the southeast.

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The observer was warmly received by the Spanish Commander and shown such activities as time would admit. We returned over the same road to Tangier the following day. August 29 was spent in conference with Mr. Blake and visiting officials of the city. At 6 A.M., August 30, the observer left Tangier in an auto en route to Larache. This latter place is about 90 kilometers southeast of Tangier, located on the Atlantic Coast at the mouth of the River Loukos. It is reached over a good macadam road or by sea, although there is no harbor nor docks at which to land; no railroad connects Tangier with Larache.

The P.M. of August 30 was spent here in order to pay respects to the Commanding General who commands the Atlantic strip of the Spanish Zone. Here a number of staff officers were met who proved good contacts during a later visit to the Spanish Zone.

AIRPLANE VIEW OF THE ATTACK AND CAPTURE OF A MOROCCAN VILLAGE

At an early hour August 31, the journey by auto was continued and by noon El Ksar El Kebir, the last Spanish town before entering the French Zone, was entered. A few kilometers south of this town is the boundary and before being allowed to proceed in the French Zone it is necessary to submit to a rigid customs inspection. After a clearance is issued no further interruptions occur, and the journey continues over a good road that follows the coast, passing through the important towns of Sk el Arba, Kenitra, Sale, across the river Sebou, and we entered Rabat, the present Capital of Morocco, about 6 P.M., September 1. Here the Sultan of Morocco, Moulay Youssef, has his residence, and here the French Resident General has his headquarters and conducts the administrative affairs of Morocco.

During September 2 and 3, the observer remained at Rabat, reporting to the Resident General, and presenting press credentials to the Press Bureau. At daylight September 4, the journey was continued to Fez. The most convenient means of transportation is by auto. The road is very good macadam, and passes through the city of Meknes, which was used as headquarters for Marshall Petain during active operations in 1925.

There is a standard gage railroad from Rabat to Fez, but little used for passenger transportation. Accommodations are poor and the line runs north through Kenitra then to PettiJohn, Meknes, and finally to Fez. Most passenger traffic and all tourist is by autobus or automobile.

The observer arrived at Fez, September 4, at 6 P.M., twenty-two days after leaving Washington.

Headquarters of the French Army in Morocco was located at Fez, which was also to serve as headquarters for the observer during his stay in Morocco. Comfortable quarters were found at the Hotel Trans-Atlantic and several days were spent in becoming oriented.

There was an atmosphere of great activity everywhere, as operations were going on in all the sectors. It was Marshall Petain's purpose to arrive at the assigned objectives before the rainy season set in.

At the time of arrival of the observer in Fez, there were war correspondents from the United States, Great Britain, France, Italy, and Switzerland. The position of the observer was soon found to be a delicate one, officially accredited as a war correspondent and known at army headquarters to be a general staff officer from Washington, and during the daily conference of war correspondents with the press censor it was felt the observer was considered with some misgivings.

It was only after several weeks and with the influence of Marshal Petain and General de Chambrun, that the suspicion attached to the observer was dissipated and the confidence of the Army Commander and his staff as well as that of the sector commanders was gained and the observer was free to visit any part of the front at any time.

Now let us look at the enemy who has been able to maintain himself against a force of 150,000 French and 125,000 Spanish, armed with all the latest weapons developed by the Great War, that could be employed in a country like Morocco, well organized, disciplined, and trained in methods of warfare.

The people commonly called the Riffs, inhabit the mountainous country in the northern part of Morocco, located mostly in the Spanish Zone of Influence. For generations they have lived an independent life; for generations they have lived in an atmosphere of war. When not actually engaged in war against Christian invaders, they have carried on a feudal warfare among themselves. They are hardy mountaineers, with great powers of endurance, and thoroughly familiar with the mountainous terrain over which they operate. They are accustomed to hardship and privation, have a very low standard of living, depend entirely for a livelihood upon their herds and crops, and although of Mohammedan faith, are of Berber origin and not so religiously fanatic as the true Arab. Their women do not veil the face. These Riffian tribes have had very little contact with European influence and civilization. This condition is confined largely to those tribes inhabiting the country north of the Ouergha River. South of this river the majority of the tribes have come under French influence and are more peaceful and inclined to agricultural pursuits.

Among the most powerful tribes that inhabit the Riff Mountains is found the Beni-Ouriaghel, having a most decided taste for domination. From this tribe came Abd-el-Krim, a man of intelligence and foresight and ability to organize and command. He was born in 1882. His father was the Caid of Ajdir. Krim, from early youth, realized how important it would be for him to be trained in European ways. He followed the Spaniards, gained their confidence and became Cadi of Melilla, which office he held from 1915 to 1919, when by reason of his intrigues he came under suspicion and was dismissed by General Sylvestre, the Spanish commander.

He returned at once to his tribe, plunged into rebellion, and forced his leadership upon the tribes which he called one after the other to "dissidence."

Although it is reported he reigns by terror, nevertheless a great number of subjects obey his rule and acknowledge the prestige which he has won by real successes. The French admit he is an adversary to be taken seriously, whose ability it would be foolish to deny.

He has taken precautions for the continuity of his work in case he should disappear, and has established a veritable family oligarchy with dependable lieutenants, chief among them being his brother Si-Mohammed-Abd-el-Krim who has a good reputation as a soldier.

Krim's first real success against the Spanish occurred in the Melilla Sector in 1921. He was responsible for the uprising of the Moors which resulted so disastrously to Spanish arms. This entire Spanish front was abandoned and in the retreat to Melilla over 15,000 men were captured or killed. Included among them was General Sylvestre, the Spanish commander, who had dismissed Krim in 1919. He disappeared and was never heard of again.

ABD-EL-KRIM'S HOUSE BEING BOMBED FROM THE AIR

One of the important results of the operations against the Spanish troops has been to give the Riffs much experience in the methods of modern warfare, and large quantities of arms, ammunition, and other supplies have fallen into the hands of the Riffs, as well as large numbers of Spanish prisoners who are held for ransom and exchange either for money, arms, ammunition, or other needed supplies.

In 1924, with continued success against the Spanish which resulted in their withdrawal to the coast and the abandonment of a large part of the Spanish Zone, the spirit of disaffection gained ground rapidly in French North Morocco. The tribes situated near the political frontier were only awaiting an opportunity, in fact a signal to rise in rebellion and to call upon the tribes to the south of the Loukos, the Ouergha, the Lebene and the Msoun, to follow them. These tribes had been peaceful and loyal subjects up to this time.

Toward the beginning of 1925, Abd-el-Krim hoped to extend his authority over the Riffians, Djebalas, and other groups of Northern Morocco capable of furnishing over 100,000 warriors. To arm them he had available

modern rifles, some artillery and machine guns, and abundant ammunition, the results of his former conquests. He counted on new captures to enlarge his supply of ammunition. This was to be a sudden attack directed against the French. He also expected an uninterrupted flow of contraband.

This force of over 100,000 warriors were hardy mountaineers fearing neither fatigue, privations or death, incomparable marchers, infantry and marksmen of the first order, eager for plunder and booty, skilled in taking cover and from concealment making sudden attacks with rifle in hand and knife in belt, upon the order of their leaders. Such was the force Abd-el-Krim was able to command against the French early in 1925 when he launched his attack which forced the French to withdraw to the south, fighting a delaying action, and hoping reinforcements would arrive in time to prevent the capture by the Moors of Fez, Taza, and other important cities.

At the beginning of August sufficient reinforcements from France and Algeria had arrived and the Army of Morocco was organized. The army was organized with seven infantry divisions, corps, and army troops, with General Naulin in command. With headquarters at Fez, he held the army troops and the 3rd Moroccan Division in reserve in the vicinity of Fez.

The theater of operations, which was all territory north of the line Meknes, Fez, Taza, Guercif, to the boundary between the French and Spanish zones, was organized into three sectors. The East Sector was commanded by General Boichut, with headquarters and corps troops located at Taza. The sector was held by two divisions.

The Center Sector was commanded by General Marty, with headquarters at Fez, and corps troops to the north. The sector was held by two divisions.

The West Sector was commanded by General Pruneau, with headquarters and corps troops at Ain Defali. The sector was held by two divisions.

The troops of all arms available for the organization of the army totaled about 150,000 men, not including certain auxiliary native units, i.e., Goums, Mehallas, Makhzens, and Partisans.

The Goums are mixed infantry and cavalry troops usually stationed in isolated regions; the other auxiliary native troops are called for certain periods of time when certain operations are projected.

With the arrival of Marshal Petain in July and the organization of the army in August, active operations commenced on the front of all three sectors. The missions of the army assigned by Marshall Petain were:

(1) Recovery of all territory abandoned in April and reestablishment of most important parts on right bank of the Ouergha;

(2) The main project was to be a wide extension of French occupation to the north of Taza, toward the end of September and beginning of October, with a view to occupying the frontier of the Riff.

Marshal Petain knew it would take a long time to carry out this plan because of the absence of roads and trails and the difficulty of the mountainous terrain over which it was necessary to operate, and against an enemy trained for generations in guerrilla warfare.

Soon after the arrival of the observer in Fez, it was learned an important operation was to begin on September 11 for the purpose of widening the two bastions of Terual-Tafrant and Tacunat, and pacifying the powerful tribes of the Benzi-Zeroual and the Mtious, who had joined Abd-el-Krim during his advance southward from April to July 1925.

Accordingly, the observer in his capacity as a war correspondent, was authorized to accompany the advance and was instructed to report to M'Jara, which was to be headquarters of General Pruneau, Commander of the West Sector, during the operations, and was to be the initial point of concentration of the 69th Brigade of the 35th Division.

No transportation was furnished by the military authorities, and it was necessary for the observer to find some sort. After much difficulty, a Ford was rented and the observer left Fez at daylight September 9 for M'Jara. The driver did not know the route, and the available maps being poor, the camp was not reached until about 8 P.M. the same day. It was expected accommodations in the form of shelter and mess would be furnished, but it was found no provision was made for newspaper men and the observer was informed he would have to provide the necessary transportation, sleeping, and messing facilities while visiting at the front. Much discomfort was experienced on this, the first visit to the front, but on future visits precautions were taken to provide the necessary means of transport and existence.

The troops concentrated at M'Jara consisted of a mixed brigade (69th), i.e., Infantry 5 Battalions Colonial; Artillery, 1 battery 155-mm. Howitzer; 2 batteries 75-mm. guns; 1 battery 65-mm. mountain guns; 1 battery 105-mm. mountain guns; Tanks, 1 company (15 tanks); armored cars 6;

DURING THE ADVANCE NORTH OF KIFANE, OCTOBER 1, 1925

cavalry, 1 troop Spahis; balloon, sausage, 1; air service, 3 squadrons; supply train (5 ton trucks); each battalion of infantry accompanied by its mule train.

At 4 A.M., September 10, the troops began to move out from M'Jara en route to Teroual which was the advance post at this time and which was to be the jump off line of the 69th Brigade at daylight on September 11 in the first day's advance, to Haddarine and Ain Bou Aissa.

What appeared to be chaos and confusion among the troops during the early hour movement, soon straightened out into an orderly column on the march. The terrain was rough and the tanks, armored cars, and supply trucks had great difficulty in getting over the poor road. However, by nightfall all elements were in their positions for the jump off next morning.

Conferences were held at which the division and brigade orders were freely discussed and the division and brigade commanders made a personal inspection of the units that were to participate in the advance.

During the night the camp was subjected to harrassing fire from the enemy. At daylight, with troops ready for the advance, the artillery (all pieces of which were in position for direct fire, except the 155-mm.

howitzers) opened up short but intensive preparations, sweeping the crests in front with high explosive shell. Upon lifting of the fire the advance began, preceeded by tanks and armored cars, followed by the infantry, accompanied by artillery fire from guns in position and by mountain artillery following the troops. The principal resistance met with was from the flanks that had not come under artillery fire. The colonel commanding the brigade with his staff (to which the observer was attached) followed the axis of advance about 1,000 yards in rear of the front line and although equipped with powerful field glasses, the observer did not see a single Riffian during the day's advance.

The advance of the troops was as rapid as the intense heat and difficult terrain would admit of and the day's objective, Haddarine and Ain Bou Aissa, was reached by 11:30 A.M. without much resistance from the enemy. These posts are the most advanced ones in the French Zone in this sector and it is here where all signs of roads end, and further advance must be made unaccompanied by wheel transport of any kind. Haddarine and Ain Bou Aissa were among the first posts to feel the weight of attack by the Riffs in April, 1925. Both were captured and a tragedy occurred at Ain Bou Aissa where the post held by a lieutenant and sixty men was blown up the day before the relief column arrived and the entire detachment killed.

The afternoon and night of September 11 were devoted to organizing the positions and getting up supplies preparatory to the advance, on September 12, to Amjot. The Riffs kept up a harrassing fire on the camp during the night and a number of casualties resulted. There was much suffering on the part of men and animals because of lack of water. None was to be had until the river was reached next day, but as this is not unusual in this country during the hot months, the troops accept the condition without complaint.

By daylight, September 12, all the artillery was in position and the troops ready to move out after the artillery preparation. This was completed by 5:30 A.M. and the advance begun. Very little resistance was encountered and the river was reached at an early hour. It was practically dry; stagnant pools only were to be found and men and animals drank together of water that under normal conditions it is doubtful if even animals would touch. The objective for the day was reached by noon and organization of the positions immediately begun. This was to be the limit of the advance and it was necessary to take every precaution to prevent successful counterattacks by the Riffs.

The troops that participated in the operations of the 12th consisted of infantry, mountain artillery, with detachments of engineers and Medical Corps, with airplanes in the air bombing the villages in advance of the troops. Such supplies not carried on the troops were transported on the backs of mules, organized into large transport columns, carefully guarded by cavalry and following closely the advancing troops. The above description of a two days' advance into the Riffian country is an example of the great problem confronting France and Spain in the attempt to subdue Abd-el-Krim and his tribesmen.

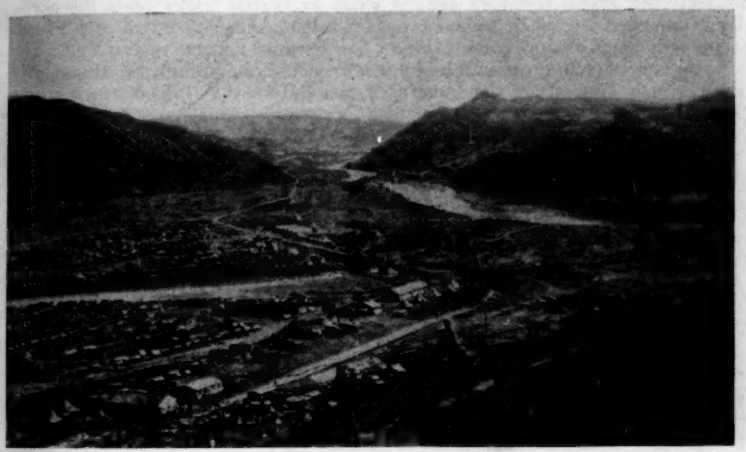
This is a war in which the only objectives that present themselves to a well organized force is a piece of terrain to occupy, the enemy will not stand before the advance of a strong column. There are no roads, railroads, or centers of strategical importance to be occupied; their villages are small and widely scattered, and abandoned by the inhabitants upon the approach of an enemy. Added to the above difficulties are other and more serious obstacles to overcome. There are the intense heat, lack of water, absence of roads and even trails, and the difficult terrain. All these obstacles are aids to the Riffian soldiers in combating an invading force, and it was very apparent to the observer during the seven days he was with the French on this operation that the employment of European soldiers in

this country and against such an elusive foe could not meet with success until after years of acclimatization.

The greatest danger that confronts a column which penetrates into the hostile territory, is the possibility of a forced withdrawal due to lack of water or supplies for men and animals.

The method adopted by the Riffs, and which has proved so costly to the Spanish as well as French forces, is to fall back before the advance of a strong column and harrass the advancing column with rifle fire from behind rocks and other shelter. When the column halts it is a signal for the scattered Riffians to gather in small squads and increase the harrassing fire, and upon the first indication of a withdrawal or retreat the enemy attacks with great courage and ferocity. They never fail to inflict heavy losses upon a retreating column.

At least 75 per cent of the troops employed by the French in Morocco are Colonials, and there is no doubt this fact is responsible for the French success and the Spanish failure in their respective zones of influence.



THE ADVANCE SUPPLY BASE AT AIN AICHA

In other words, the French fight fire with fire, while the Spanish employ about 10 per cent of native troops, the other 90 per cent being true Spaniards.

The observer remained three days with the French troops in front of Amjot. During the day the troops were busy organizing the positions and the convoys transporting supplies, heroic work under the burning sun, and the long climb from the valley to the heights occupied. During the night the Riffs kept up a constant harrassing fire on the camp, and flares were fired at irregular intervals lighting up the surrounding country for the purpose of detecting any Riffs in an attempt to creep up and throw hand grenades into the trenches.

The above is an example of the nature of warfare carried on by the French across their entire front, after assuming the offensive early in August, and continued until all objectives were reached by October 15, when the front stabilized and preparations were begun to meet the terrors of the rainy season.

The defensive organization consisted of reorganization of the theater of operations into an East and West Sector, the East commanded by General

Marty, with headquarters at Taza, and the sector to be defended by two divisions with a reserve and advance supply base at Dar Caid Metbou.

The West Sector to be commanded by General Boichut, headquarters at Fez, the sector to be held by three divisions with a division in reserve at Meknes and Fez, advance supply base at Ain Aicha, M'Jara, Ain Defali and Quezzan, army headquarters to move from Fez to Rabat where the army commander would be located beside the Resident General (Steeg) who was to assume complete control of French affairs in Morocco.

The front of 240 kilometers was to be held by 60 battalions composed of Algerian, Moroccan, Senagalese, Zouaves, and Foreign Legion, no complete French units to be employed, all units commanded by French officers and N. C. O. All advance posts were to be battalion posts, equipped with artillery and other auxiliary weapons, surrounded by barbed wire, and adjacent posts within supporting distance of each other. In front of this defensive line at intervals is a curtain of Partisans, or Volunteers, from the pacified tribes who, supported by the French, are employed to protect their tribal territory against raids by hostile tribes from the north. By November 15, when the new organization went into effect, the French Zone was pacified and conditions of life became normal again.

The end of active operations in the French Zone found the situation in the Spanish Zone about the same as it was before the Riffian attack on the French in April, 1925. The Spanish occupation consists of control over a narrow strip extending from El Ksar El Kebir to Tangier on the Atlantic Coast; the Tangier-Tetuan Corridor; the road from Tetuan to Ceuta; a small bridge head at Ajdir; and the well organized sector of Melilla.

The greater part of the Spanish protectorate is controlled by Abd-el-Krim. It is a country of high mountains, no roads and no railroads. Method of transportation is by mules or women and over narrow trails. It is a country difficult of development even in peace time, and occupied by warlike tribes the Spanish have never wholly pacified.

On the other hand, France occupies that part of Morocco containing great potential wealth. The vast plains and valleys easy of agricultural development and affording abundant pasturage for herds of cattle, goats, sheep, and camels, are peopled by tribes more inclined to peaceful pursuits.

France has been most successful in the administration of her protectorate. Good roads and railroads connect all the large cities and important centers, and others are being built. Modern cities are being built alongside the old Arab cities. French officials respect and protect the people in the execution of their civil and religious laws. Today the Mosques and other places of Mohammedan worship are held as sacred in the eyes of the European as they were in the days of the Prophet.

The French high officials receive the Moroccan officials in their homes, entertaining them at receptions and dinners, and accept in return invitations to the homes of Moroccan officials.

Outstanding service rendered by Moroccan officials or soldiers is promptly rewarded by the bestowal of the Medal of the Legion of Honor, which has a great appeal to the oriental mind. The treatment of native troops by French officers is always kind but firm, and there are few instances where these troops have been disloyal to their officers. The French are no doubt meeting with great success in their civilizing influence over a people who have progressed so little in modern ways of civilization, and who today in their markets and large cities are carrying on in much the same way as was done a thousand years ago.

In conclusion it can be safely stated in the first requisite necessary to insure success in the war in Morocco is roads, more roads, and railroads. The question of transportation is the greatest of all obstacles that confronts the military. In the absence of roads, wheeled transport can-

not accompany the light columns which must be mobile, and must transport needed supplies on mules or camels organized into convoys which are vulnerable to attack and must be carefully guarded by strong detachments.

Mountain artillery alone can accompany the columns beyond the point where roads end. Tanks and armored cars have not been able to render much service except where roads were available and then the intense heat will not allow the men to remain inside for long.

Cavalry cannot be used in advance of the column operating in mountainous country. It affords a splendid target for the concealed and widely distributed Riff riflemen. As a result, cavalry is used on the flanks and rear and guards the convoys. No European cavalry is employed in the French Zone. The cavalry used consists of natives mounted on small Arab ponies, hardy and with great power of endurance.

A Group of Mehellas: Permanent Infantry and Cavalry at the Disposal of the Native Chiefs

The French do not employ poisonous gas against the Riffians, although it is freely used by the Spaniards who have a small gas plant in operation near Melilla.

The air service has operated with varying success and failure. With success in carrying limited supplies to posts cut off by the Riffs in the early months of 1925; by photographing terrain and furnishing details useful to commanders of advancing columns and accompanying infantry with its fire by liaison with front line troops and the rear; by reconnaissance; by bombardment of villages, sensitive points and of herds of cattle, and finally by evacuation of seriously wounded from the front, where the sick and wounded are normally transported to the rear ambulance on the backs of mules.

The air service has failed to destroy the morale of the hostile tribes and to inflict serious loss on them. The difficulty encountered by the air service lies in the fact that there are no tangible enemy objectives to attack, no railroads, no roads, no important towns or cities, villages widely scattered and abandoned on the approach of airplanes, cattle are taken to water and fed during the night, and the limited air service available to cover this vast and mountainous terrain.

The result is limited bombardments at varied intervals which do not have a lasting effect on the minds of the people.

Artillery up to 155-mm. caliber can be used to good effect where roads permit movement, but in the last analysis the principal arm is the infantry equipped with machine guns and mountain artillery on pack mules, the whole made as mobile as possible while retaining a maximum of striking power. This with the continued construction of roads, will solve the problem now confronting the French in Morocco.

Anton Flettner

A Talk With the Inventor of the Rotorship, By Felix Riesenberg, *The Nautical Gazette,* 8 May, 1926.—For the past two hours I have been talking with Anton Flettner. The staff of *The Nautical Gazette* has invited Mr. Axtell and myself to meet the distinguished engineer at the Railroad Club, and the conversation, during luncheon, has left an impression of a man of remarkable simplicity and directness. Anton Flettner is just turned forty, blond, big, genial in a subdued way, with very blue eyes and a pleasant smile. He speaks English without effort and with only an occasional appearance of hesitation, when searching for just the right word needed to convey his thought.

His invention of the famous Flettner rudder, and his invention of rotor propulsion, takes him back to the sea toward which he was inclined as a boy. Color blindness prevented his following the calling of a sailor.

"For a long while I had been experimenting and studying at the University of Goettingen with a view to making some practical application of the little known laws of the sail. The curious mechanical principle known since 1852 as Magnus Effect seemed only a puzzling scientific fact. It is of interest to note that Magnus, a German scientist, was teacher to Helmholtz. A French savant by the name of Lafay had re-examined the Magnus law. In 1921 the people of the University of Goettingen undertook such trials for theoretical purposes only. It was at that time that I made my first invention and it was then that we made the experiment in search of the rotorship, discovering that a rotating cylinder turned by a small motor produced a decided lateral pressure, which in turn might make an effective propulsion for ships."

Mr. Flettner, unlike many inventors, is not so filled with his great discovery that he goes without stopping. He was courteous in replying to questions, and both Mr. Axtell and Mr. Van Arx brought out interesting lights during the course of the discussion.

"It is now eight years since the rotor principle was first announced. At the beginning, practical shipping people, like the Hamburg-American Line officials, laughed at the idea of a ship fitted with towers, revolving or otherwise.

"The fact that the towers are very light, and very strongly braced on the inside, and only weigh one-fifth as much as the masts, yards and rigging of a ship, began to be considered. Perhaps, after all, it might be a practical thing, so shipping men were saying.

"One point about the rotors that makes them specially effective, a point not easily explained, is the fact that the flat discs at the top, overlaying the surface of the cylinders, increasing the effectiveness of the rotors one hundred per cent.

"In the *Baden-Baden*, due here by about the 9th of May, the rotors are constructed of steel, one millimeter in thickness."

Mr. Flettner then showed us photographs of rotor yachts racing with yachts of similar size and fitted with the approved Marconi rig.

"The rotor yachts sail faster on all points, and also point higher, going to within three points from the wind. Tacking, in these and in all rotorships is accomplished by simply putting down the helm."

I asked especially about the point of sailing *close hauled*. Just what the appropriate term would be in a rotorship is not clear. The motors, as finally designed, permit of a very effective working to windward, the component of force, in line with the keel of the ship, being greater than in the ordinary sail with its comparatively simple resolution of the forces of the wind.

"Do you know what makes a sailing ship go?" Mr. Flettner asked.

I did make a stab at saying something about the pressure on the surface of the sails, translated through the masts, and resolved by the sidewise resistance into leeway and headway.

"But the most important of all," so Mr. Flettner said, "is the *difference in pressure* between the windward side of the sail and the leeward side. The *sum* of this difference measures the effective work of the sail. In the rotor this difference of pressure is magnified very many times because of the rapid rotation of the towers or rotors. The wind moves away from the approaching edge, or side of the rotors and whirls around with the receding side, piling up pressure and translating it into longitudinal effort. Rotor area is ten times as effective as plain sail area."

"How about maneuvering?" I asked.

"Simple. The officer in charge can control both the speed and direction of the rotors by means of controls. He can send his ship astern by simply reversing the direction of rotation. He can reverse one tower and leave the other run and can so control his ship in the most satisfactory way."

"But——?" I was full of questions as were the other men at the table.

"The answer is in the actual doing of what we say we will do. The *Baden-Baden* is on her way over here so Americans may see for themselves. We have just launched a much larger rotorship, the *Barbara*, a three-rotored craft to play between Germany and the River Plate. She was built at the A.G. Weser, near Bremen. Her towers are of a new aluminum alloy, called Lautal, and her accommodation and powering will be the very best. She will develop 1,200 horsepower by rotor, on a turning power of only 90 horsepower.

"The fuel saving in rotorships, as now designed, is approximately forty per cent over favorable routes where trade or other winds may be depended upon.

"By fitting out vessels with rotors we look upon the rotor installation as an auxiliary to the engine."

"In regard to my rudder, 500 airplanes have so far been equipped with it and it has been installed on one hundred big ships."

This, in plain words, without regard to effect or trimmings, was the talk about the table with Anton Flettner. Unlike many enthusiasts, he is intensely interested in everything American, and wants to listen more than he cares to talk. New words interest him. Mr. Van Arx mentioned the Ford plant. He was at once puzzled at the word until *plant* was explained by the German word *Fabrik*.

At the close of our party he desired to know what the huge building at 30 Church Street was and when told it topped the Hudson Terminals he eagerly accepted an invitation to inspect the concourse below.

A very interesting man, and soon to be followed by perhaps the most interesting seagoing craft that has entered the harbor of New York since Fulton steamed the *Clermont*, or Hudson dropped anchor with the *Half Moon*.

Earnings of Graduate Mechanical Engineers

Engineers and Engineering, May, 1926.—The average earned income of graduates of the Mechanical Engineering Department of the University of Pennsylvania during their first year after graduation is $1,800. The

fifth year after graduation, the average is $3,000, and the tenth year, $5,950.

Dr. R. H. Fernald, Director of the Mechanical Engineering Department of the University's Towne Scientific School, compiled the statistics from the replies to a questionnaire in which the graduates were asked to record only straight salaries or earned incomes.

All the department graduates of the classes of 1913 to 1924 inclusive, whose addresses were known to the department, received the questionnaire, and 220, or eighty-six per cent, replied.

The survey shows that not a single graduate met with phenomenal financial success in the engineering profession in a short time, but virtually every man recorded steady progress as reflected by salary increases, except during the period of depression following the World War when the salaries of the majority either remained stationary or dropped slightly.

As compared with the class of 1913, members of the class of 1924 earned more than twice as much during their first year following graduation, a circumstance undoubtedly accounted for principally by the relative values of the dollar for the dates named.

A brief summary of the salaries received by the graduates during their fifth year after graduation is as follows: Two per cent received $5,000 to $6,000; six per cent, $4,000 to $5,000; thirty-two per cent, $3,000 to $4,000; forty-four per cent, $2,000 to $3,000, and sixteen per cent, $1,000 to $2,000.

The tenth year after graduation, eleven per cent of the members of the classes of 1913, 1914, and 1915, were receiving salaries ranging from $10,000 to $13,000; seven per cent, from $7,000 to $8,000; two per cent, $6,000 to $7,000; thirteen per cent, $5,000 to $6,000; eleven per cent, $4,000 to $5,000; thirty-eight per cent, $3,000 to $4,000, and eighteen per cent $2,000 to $3,000.

Of the eighty-three men who reported from the classes of 1913 to 1917, all of whom have been out of college at least eight years, forty-one per cent now are receiving $5,000 a year or more; twenty per cent are receiving $7,000 or over, and ten per cent are receiving $10,000 or over.

In commenting on the survey for the benefit of students in his department, Dr. Fernald said that while he considered "salary curves" decidedly interesting, he did not believe they alone indicated the value of university-trained men.

"It is generally agreed that education, intelligently applied, increases a man's earning capacity, but that is not its primary object," Dr. Fernald told the students. "Higher education equips a man for far greater service to the community than any which can be measured in terms of dollars and cents.

"Men like you who are enjoying the privileges of higher education owe the world something when you leave the university. Your 'salary curve' shows what you are getting. That is important. But watch the 'service curve' which shows what you are contributing to the betterment of your profession and the world in general. That's the real measure of your worth."

Battleships on the Pacific

Capital Warcraft Essential for Any U. S. Naval Campaign in Orient, by Clifford Albion Tinker.—A sincere questioner, after reading the proposal that the United States take over the French-Oceania islands as fuel and repair waystations for American trade routes to the Antipodes, printed in a recent issue, asked if it was intended that the United States embark on an imperialistic orgy? The answer to that question is this: We are not now required to make a decision on that matter; we have already made a decision, and we became as imperialistic as we ever shall be when we annexed Hawaii, took the Philippines, Porto Rico, Guam and Samoa,

bought the Virgin Islands, and built the Panama Canal. The great step has been taken, and the suggestion is that we bring our right foot up alongside of our left and stand firmly on both feet.

"But," the questioner went on, "isn't it looking pretty far into the future to talk of probable conditions one or two hundred years hence? It is not quite likely that the development of aircrafts or some other kind of war machine not yet even thought of will change all methods of warfare long before the time mentioned and for which, in the article, our naval needs are forecast?"

The obvious reply to these questions is that methods may change, but fundamental strategy never does nor is it likely that aircraft or any other type of weapon will be developed without this country having aircraft and the new weapon in their most nearly perfect stage. It is the principle of providing for the future that is being stressed.

A Chinese Prediction

For instance, let us quote from a book written by a Chinese more than 2,000 years before Christ was born, when all Europe was a wild and trackless waste and wilderness, except for a little fringe of settlements around the rim of the Mediterranean, when the Greeks were just emerging from barbarianism, and some 3,500 years before this hemisphere was discovered. This book is on the subject of military warfare. The author's name was S'uma Ch'ien. He wrote this:

"What, then, can be said for the scholars of our age, blind to all great issues and without appreciation of the relative values, who can only bark out their stale formulas about 'virture' and 'civilization,' condemning the use of military weapons. They will surely bring our country to impotence and discord and the loss of her rightful heritage, or at the very least they will bring about invasion and sacrifices of territory and general envelopment."

No truer prophecy has been handed down to man; 4,000 years of Chinese history proves it; the present chaotic condition of China is its dire fulfillment. Thus it is that a search into probable trade and political conditions one or two or even five centuries hence is not an extremely remote era for present-day consideration, that is, if we judge by Ch'ien's prophecy, and are willing to read its lesson aright.

Indeed, it was only thirty-five or forty years ago that James G. Blaine was making such statements, in his speeches, as the following: "It is not an ambitious destiny for so great a country as ours to manufacture only what we can consume, or produce only what we can eat." The great statesman wanted his countrymen to understand that the time had come in the affairs of the nation for them to turn their eyes outward, to lay the foundations of a world trade, the world-wide trade, to boot. How well his message was heard, and how sound its premise, is best illustrated by the fact that we have "looked outward" so effectually in three or four decades that our world trade for 1924 was nearly $8,450,000,000 at standard rates of exchange.

Responsibility of Government

When a people, by the exercise of natural gifts, the employment of inventive genius, the stimulation of inherent physical strength, and the development of financial sagacity, expand their industries to include such an enormous international marketing as evidenced by the vast sum named, their government must assume definite and imperative responsibilities in connection with the protection and maintenance, if not the further expansion, of that trade and its contributing industries. This logic, implied in Blaine's speech, is nothing new. It was, as we have seen, emphasized by the prophet Ch'ien 4,000 years ago. Our present problems in connection with trade pro-

tection and maintenance, based on this age-old logic, are quite intricate and perplexing; future problems are still more formidable, and they require immediate consideration.

It is a deep understanding of the future needs of her industries, of the possible expansion of her international trade, of the probable menace of other maritime trade developments on competition with her nationals, and the desire for a free hand in the "Asia for the Asiatics" movement, that caused Japan to join Great Britain in a program before the proposed League of Nation's arms reduction conference for the complete abandonment of battleships and the scrapping of all cruisers above 6,000 tons displacement. In other words, Japan is desirous of abolishing all offensive naval armament. She is just as strongly opposed to the scrapping of submarines and the curtailment of aircraft as she is anxious to see the last of battleships and large cruisers. Aircraft and submarines, in her case, are defensive weapons of proved value.

Even the novice in naval strategy can readily understand what the Japanese statesmen are driving at, and a brief survey of Japan's offensive and defensive problems will demonstrate the soundness—to Japan—of their proposals. A glance at the Asiatic section of the atlas will suffice. We find that Japan's immediate sphere of influence and action is embraced in that area lying between the equator and the 57th parallel of north latitude, and the 114th and 171st meridians of east longitude. This area contains the Japanese Empire, Korea, Sakhalin, and these insular possessions and mandated islands which may be considered Japan's colonial outposts. All this territory and its insular appendages is sufficiently compact to permit of a defensive plan which is simple and charged with the elements of success provided, however, that battleships and large cruisers are eliminated from consideration. Against the employment of these classes of ships, Japan's defense is vulnerable and must so remain. Japanese offensive operations beyond the limits of this area cited are not strategically practicable under the limitations of the 5-5-3 naval treaties.

Shipbuilding in Japan

Shipbuilding facilities in Japan proper, yards, and raw materials, make it possible for the Nipponese to build relatively small cruisers and submarines in large numbers and with despatch, but three years is the shortest period in which she can complete a quartet of battleships of battle cruisers, nor can more be laid down until those under construction are launched and the yards cleared. A certain definite quantity of steel may be used to build a large number of small craft or a limited number of large ones, just as a million brick will build a large wall or a number of small walls, a matter of choice with the builders. If Japan, to meet the menace of battleships, is obliged to use up her limited supply of steel in building such craft, she must forego small cruisers and submarines, but if battleships are abolished, and the menace removed, she can concentrate on a small-cruiser and submarine building program of amp'e proportions to meet her probable defense requirements. Hence her desire to see battleships and near battleships cruisers erased from the list of naval armament.

Raw Material Difficulties

Japan may, of course, solve her raw material difficulties by the mere expedient of annexing ore-bearing Chinese territory, but such a course is not the simplest of international problems; it would mean war. At this writing allegedly reliable reports are rife that Japan is backing the Chinese war lords who are fast gaining control of the Peking Government. If so, Japan may be enabled to control for a comparatively long period after the beginning of possible hostilities, a huge supply of coal and iron in Chinese territory adjacent to Korea and just across the Yellow Sea from

Nagasaki, Japan's largest naval port and ship-building center. Such activities are a breach of the spirit of the treaties evolved at the Washington Conference, treaties in which the great powers are bound to respect the territorial integrity of China, Japan among the rest. A flagrant violation of these treaties would bring down on Japan's head the armed forces of the other signatories, an eventuality not relished by the Japanese Government, whose declared alternative, however, for great control of China's destiny is the abolition of battleships and large cruisers.

As in the case of England, looking at the matter of battleship and large cruiser scrapping from the Japanese standpoint, one would be justified in saying, "All right, go ahead and scrap 'em." But from the standpoint of the United States, the thing simply cannot be done. Here are the reasons. In the first place, it must be admitted that our administration, with the ratification of the Senate, by accepting the terms of the treaties of *status quo* ground out at the Washington Conference in 1921-22, gave notice to the World that we felt unequal to the task of protecting the Philippines and our Far Eastern trade by force of arms, and henceforth would rely upon diplomacy for that protection. We signed away our right to build naval bases adequate in size and protective strength to care for our fleet when mobilized in the Far East. The only adequate naval base for the purpose west of the Pacific coast of her continental limits, and between the canal and Manila, that the United States is allowed to build is at Hawaii.

It is the writer's humble opinion that the administration of the hour, when the *status quo* treaty was made forgot or ignored the problems of protection of our Far Eastern trade present and future, and considered the independence of the Philippines as good as granted, if it did not consider the actual abandonment of those islands by this country, no matter what their future fate might be. If the writer is wrong, the treaty is doubly wrong, for we had no business to make such a treaty, Philippines or no Philippines, if we are to consider the maintenance of our "second Monroe Doctrine," namely, the "Open Door" to China, a national policy. This statement is made on the assumption that this nation is not going to close out its trade with China and other Far Eastern markets, either because of diplomatic pressure or hostile action from any quarter.

Are we to abandon without raising a hand, the efforts of a century; the investment of hundreds of millions; the potential growth of a commerce which, in 1924, amounted to $984,450,000 for Japan and China, and $148,500,000 for the Philippines? Reason says, no. Nor is it conceivable that we shall ever abandon the Philippines to a fate unknown, whether they are given complete independence, granted a free state status, or remain as they are, American territory. They will always be our wards, willing or otherwise, until the end of time.

We have, then, Far Eastern responsibilities which require the maintenance of naval vessels possessing characteristics to enable them to proceed from Hawaii to the Far East and arrive there with sufficient fuel reserve aboard to carry out their mission, if not return to their Hawaiian base. As we shall see, the only classes of ships which can do this are battleships, fleet-submarines, and rigid airships. Six-thousand-ton cruisers, unaided cannot negotiate such a task, nor can aircraft carriers of even the largest tonnage allowable under the Washington treaties, unless conveyed by other large ships for their protection.

Really competent naval experts will bear out the statement that the only ships of our present naval force upon which we can safely rely for a victorious conclusion of a major naval campaign in the Far East are our battleships. They are the only ships we have large enough to permit of self-contained protection against submarines and aircraft. In battleship construction we can provide protective deck armor to withstand aerial bombing, and water-tight integrity and hull armor to withstand under-water

bomb, mine, and torpedo attack. No cruiser or aircraft carrier can be so protected.

Value of Battleship

I am well aware that no ship, battleship or what not, can be built to withstand prolonged aerial bombing by large bombs, nor can any ship withstand prolonged gunfire from large guns, nor remain afloat after being struck by a large number of torpedoes or mines. But in a general mêlée, the strongest ship will survive the longest and that ship is the battleship of today. It is not here contended that the battleship, as such, will always retain its present characteristics unchanged. It may be that the battleship, perhaps more properly named capital ship, in years to come, will be a submersible, an armored aircraft carrier, or even a flying-ship, but characteristics which it must always retain are the ability to concentrate power in attack, to give and take the heaviest blows, and to overcome the strongest ships that can be brought against it. If Great Britain's desires are consummated at the League Arms Conference, and battleships, large cruisers, and submarines are abolished, the huge ocean liners of the *Majestic* and *Berengaria* type, when armed, will be capital ships. For with the curtailment of aviation, aircraft carriers will give place to planes carried on individual ships, such as is the case with our battleships and cruisers. As long, however, as submarines and aircraft are unlimited in size and number, the present type of capital ship, the battleship, will remain our chief reliance for victory, especially in the Far East.

While we will not here discuss those conflicting interests in the Far East which point to possible hostilities, and which are particularly inimical to the United States, we cannot entirely ignore them, for they are proceeding in the direction of definite threats against the "Open Door," and presage a stormy future for our Far Eastern trade. Reference is here made to the bargain between General Feng, the "Christian General," and the Soviet leaders resulting in the use of Russian money, munitions, and officers in the titian struggle for complete control of China, with the expectation that Russia will dominate the new Chinese Government and obtain permanent control of the railroads into Tientsin and Tsingtau, the government of Chi-li province, and a year round open port in ex-German Tsingtau on the Yellow Sea; to the efforts of Japan to offset the Soviet program; to the Soviet-inspired demands of China for a seat in the League Council and for the abrogation of extra-territoriality, to the renewal of Great Britain's building program at Singapore, where she is creating the strongest naval base in all the world; to the fact that Japan has built or laid down four times as many naval vessels since the Washington conference as this country has; to the renewed attempt on the parts of ambitious Philippino politicians and misguided Americans for the immediate independence of the Philippines, and to the further fact that we are in the midst of the greatest trade war in history, financed against us by a large part of the $11,000,000,000 privately loaned by Americans to European trade rivals since the World War.

All these formidable activities are being minimized in the American public mind by a wealth of particularly disarming propaganda appealing to altruism and Christian sentiment, a type of appeal to which our people are ever responsive. For instance, the Japanese and their American admirers are constantly repeating, through the medium of the magazines and the press, that Japan has only the most humanitarian motives in connection with the Nipponese policies toward China, and that if Japan is a bit aggressive in carrying out those policies, it is nothing for us to criticize, for these apologists ask: "Is it not much better for China and for us to have our traditional friends, the Japanese, in control of Chinese affairs than to let the Russians, an unknown quantity, gain control and exploit the 400,000,000 Chinese in the Soviet attempt to revolutionize the world?" This

and much more sentimental drivel of a like character is being fed to us daily. It appears that any move made by Japan toward building up her army and navy is looked upon by the critics of our policies as in the interests of world peace, but the least move on our part to bring our Navy up to the 5-5-3 standard is nothing less than broiling the dove of peace on the gridiron of militarism.

Should an Asiatic war be forced upon us, its announcement would be simultaneous with an announcement that we had lost the Philippines and Guam, if not Samoa. A brief examination of the probable naval movements on our part under such a contingency will show beyond question the types of craft we must retain, develop, and use if we are to bid for success in a major naval campaign in that far-away area.

Another glance at the atlas will show that our fleet, on a war mission moving from Hawaii westward to Manila and beyond, will have to pass through numerous archipelagoes of hostile ownership, designed by Nature to serve as bases for submarines and aircraft, barriers, one behind another, for a distance of more than 2,500 miles. The alternate course, in a northward curve, lies for more than 1,500 miles along the islands of the Japanese Empire, likewise perfect, natural bases for submarines and aircraft. This places the burden of strategic scouting on the submarine and rigid airship elements of our fleet, those types only having the characteristics enabling them to elude the barriers and exercise the vital function of surprise unsupported at long distances from the main body of the fleet. This involves the building of ocean-going fleet submarines, a type we now lack. It also involves the building of a squadron of large rigid airships. Thus it is out of the question for this country to enter into any arms reduction treaties which would deny us submarines and airships.

Six-thousand-ton cruisers are too light in armor and armament, and too restricted in cruising range to, unaided, run the gauntlet of 2,500 miles of submarines-infested, aircraft-patrolled enemy territory and be fit for a fight even against their own class at the end. It is therefore evident that we cannot agree to reduce the tonnage of individual cruisers to 6,000 tons displacement. Cruisers of 10,000 tons displacement may be sufficiently armored to negotiate the passage of the defended area, and cruising range, so that this type of ship would be doubtful battle efficiency after a run of more than 4,000 miles, 2,500 miles of which would be in the nature of a running fight.

One recourse remains. Having no bases at our command in the decisive area, we must take floating bases, battleships, if you please, with us. This means that our battle fleet, our battleships and their train, become at once our main reliance. Our battleships, aided by fleet-submarines and rigid airships exercising the functions of strategic and tactical searching and protective-scouting, screened by other fighting fleet units and aircraft, and accompanied by their train constitute the only force which can possibly overcome the successive lines of enemy defense and reach the distant objective in physical condition to do battle with more than an even chance of success. Is it not perfectly obvious that we cannot be a party to the abolition of battleships? If this be militarism, make the most of it.

To want adequate protection for our trade and territory is not militarism. Militarism is not, perforce, power. But it is the motive that actuates the employment of power. The same amount of organized force may constitute militarism in the hands of one sort of nation and not constitute militarism in the hands of another sort of nation. Militarism is a thing of the soul. It is hateful to every true American.

Yet the mere hating of militarism does not relieve us of the responsibility of guarding the vital interests of the nation with whatever modest force, military and naval, our present and future safety requires. Our hatred of war and our earnest love of peace must not be allowed to reach

the stage where sentimental expediency takes precedence over calm and searching judgment when we find ourselves at these arms reduction conference sessions. Impotence on the seas does not insure peace for us, or the world; it will invite attack and precipitate war.

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NOTES ON INTERNATIONAL AFFAIRS

FROM 3 MAY TO 3 JUNE

PREPARED BY

PROFESSOR ALLAN WESTCOTT, U. S. NAVAL ACADEMY

RESULTS OF ARMS PARLEY

PROBLEMS REFERRED TO TECHNICAL COMMITTEES.—The Preparatory Disarmament Conference, with representatives of twenty nations, met at Geneva on May 18 and ended ten days later, adjourning for a period of two or three months to give the technical sub-committees time to study and report on the mass of problems referred to them.

The first work of the conference was to appoint a Drafting Committee, the purpose of which was to formulate the questions for consideration and separate political questions from those of a strictly military character which by their nature could properly be referred to the technical committees. The Drafting Committee, in its report on May 25, expressed the view that it would be impossible at present to set limitations on all the potential elements of war strength of nations, and that limitation should be confined to the definite peace-time strength of land, sea, and air forces. Methods of reduction included: (1) definite reduction of units, equipment, and munitions production, (2) reduction of service, (3) reduction of expenditures, (4) regional agreements, (5) prohibition of chemical and bacteriological warfare. Representatives of France and of some of the smaller European states again insisted that the problem of disarmament could not be separated from that of security. To meet their views, a request was sent to the League Council for an elaboration and clarification of the provisions of the League Covenant regarding assistance to be given to an attacked state. It was suggested that the duties of the council in such a situation should be clearly defined, and means devised to make its action prompt and effective.

At a meeting of the technical commission, after the conference, General Dennis E. Nolan, who with Rear Admiral Hilary P. Jones and Rear Admiral Andrew T. Long, represented the United States, presented the American point of view. He included among the potential war resources of a nation: (1) geography, topography, and climate; (2) population and social conditions; (3) the political situation; (4) the economic situation; (5) the existing military and naval establishments. He expressed the view that, although the first four factors should be given careful consideration in determining the proper size of a nation's military forces, feasible reduction must be limited

to reduction of actually existing peace-time military establishments. This view had already been expressed in the general conference by the American representative, Mr. Hugh Gibson, who also spoke favorably of the possibilities of regional agreements for limitation of armaments.

The Japanese representatives proposed a separate naval conference of the United States, Great Britain, and Japan, to consider especially the extension of the ratios of the Washington Treaty to cruisers and secondary units. Great Britain was unfavorable to such a conference, especially without the inclusion of Italy and France. The government at Washington also indicated that it was not in favor of a separate naval conference at this time, feeling that it might interfere with the results sought at Geneva.

LEAGUE OF NATIONS

REORGANIZATION OF LEAGUE COUNCIL.—The committee appointed by the Assembly of the League of Nations to consider and recommend measures for the reorganization of the League Council, in view of the difficulties encountered in the attempt to admit Germany, met at Geneva on May 10. The general trend of opinion was that there should be no increase of permanent seats in the Council beyond a seat for Germany, and that non-permanent seats should be increased only in proportion to this increase of permanent seats.

It was voted to recommend to the Assembly that non-permanent members of the Council should not be eligible for re-election until three years after the expiration of their terms, but that the Assembly by special resolution might declare one third re-eligible for a practically indefinite period. This would tend to meet the desires of Brazil and Spain, as well as China, without actually giving them permanent seats. It was further decided to recommend that the election of non-permanent members should take place at the beginning of the Assembly session, and that the newly-elected members should take their seats at once, instead of in January following, as at present. This would have the effect of bringing pressure on Brazil and Spain to acquiesce to the desires of other members and not use their veto power, lest they fail to secure re-election.

China announced that she would withdraw her demand for a permanent seat, in case Brazil, Spain, and Poland would do the same. The Polish representative refrained from pressing Poland's claims. The Brazilian representative in a long speech called for two seats in the Council for representatives of Latin America. He argued that it was never intended that permanent seats should be limited to the great powers, and further that national greatness should not be measured by military strength alone.

GREAT BRITAIN

END OF GENERAL STRIKE.—The strike in the United Kingdom, which was begun on May 1 by nearly a million coal miners and was extended on May 4 to a general strike of nearly four million workers in other fields, was ended on May 12. The general strike was precipitated when printers refused to

set type for a London paper on account of its editorial utterances, at a time when the government, miners, and operators were making a last effort to reach a solution of the miners' wage problem. Premier Baldwin refused to continue negotiations in the face of this action. The strike was ended by the General Council of Trade Unions, in view of the Premier's fixed policy of taking no steps to settle the coal problem so long as the general strike continued.

Upon the conclusion of the general strike, Premier Baldwin made proposals for settlement of the coal industry problem, offering to extend the government subsidy for a limited period pending a new wage scale agreement. The offer, however, was held open only until the end of May, at which time it had not been accepted by either operators or miners. England was then on strict coal rations, and there was a general demand for government intervention, even if it should lead to nationalization of the coal mines.

England's Coal Problem.—(From *The Living Age,* May 15).—As a rule British coal mines are operated on a royalty basis by companies that do not own the soil or mineral wealth beneath it. The title to the coal *in situ* is encumbered with a dense overgrowth of British realty and inheritance law—trusteeships, primogeniture rights, and other encumbrances that have come down from the Middle Ages. Operators are often so hampered by this patchwork of titles in laying out their underground workings that they cannot mine their coal economically. That is only one example, out of a score of others that might be cited, of the artificial and legalistic shackles upon the industry that the miners wish to have struck off before present working conditions are touched.

In respect to wages, the dispute is not only between the workers, insisting that they be maintained at the present level, and the owners, insisting that they shall be lowered, but also over the method by which they shall be determined. Payment is regulated at present on a system embodying the results of several successive agreements between the unions and the operators. After the war, when it was recognized that wages must be advanced to compensate for the rising cost of living, a national agreement was made fixing the minimum rate paid miners at 20 per cent above the standard wage of 1914. Three years later this was increased to 33 per cent. Meanwhile the standard working day was reduced from eight to seven hours.

Now the owners not only want this percentage reduced and the working day put back at eight hours, but they wish to substitute district agreements for a national agreement. They argue that in view of the great diversity in the cost of mining coal, and in the prices of coal mined, in different districts, only local boards can deal intelligently with rates of pay. As to the existence of such diversities there is no question. In some parts of the United Kingdom coal can be mined for three dollars a ton; in other parts it costs over seven dollars a ton. Some companies can sell their coal at the pit-head for eight or nine dollars a ton; others having a poorer market and producing an inferior quality must sell at three or four dollars a ton. Some have made a profit of a dollar a ton or more during the worst years since the present depression began, and others have lost money even during the best years.

But the miners insist on a uniform agreement for the whole industry throughout the nation, for two reasons. They believe that if the minimum wage is allowed to vary in different districts competition between the coal of these districts will be used to depress wages. They also believe that

the owners' effort to substitute local for national agreements is due to their desire to break up the Miners Federation, on the divide-and-rule principle.

FRANCE

RIFF WAR ENDED.—Upon the refusal of the Riff delegates early in May to accept the terms offered by France and Spain, the Allied forces renewed their offensive. On May 23 it was announced that Tarquist, Abd-el Krim's capital, had been occupied by the French, and that several powerful tribes had submitted. Abd-el Krim escaped northward, but later, on May 26, he entered the enemy lines with his family and placed himself under French protection. All French and Spanish prisoners were surrendered. While the end of the war was welcomed by France, in view of her difficult financial problems, it was feared that the peace settlement could do little to lessen the dangers involved in Spain's weak control of her Moroccan zone.

GERMANY

REORGANIZED CABINET UNDER MARX.—Chancellor Luther and his cabinet resigned on May 12 after a defeat in the Reichstag owing to the vote of the Nationalists against a motion disapproving the proposal to fly the German merchant flag, with the old imperial colors, over German embassies and consulates along with the new flag of the republic.

Four days later, Dr. Marx, leader of the Center party and Luther's predecessor as head of the cabinet, accepted President Von Hindenburg's offer of the chancellorship, retaining the Luther Cabinet intact except for a new appointment to his own former place as Minister of Justice.

The date for a plebiscite on the expropriation of the property of former rulers was set for June. In the meantime efforts were made to settle by compromise the other question agitating Germany—that of a single flag for both merchant marine and general use, which should take the place of the old imperial, black, red, and white, and the republican black, red, and gold.

EASTERN EUROPE

PILSUDSKI'S COUP IN POLAND.—On May 12 Marshal Pilsudski headed an uprising which forcibly overthrew the existing Polish Government. At the head of considerable bodies of troops Marshal Pilsudski entered Warsaw and after hostilities during which about 350 were killed and some 1200 wounded he succeeded in occupying the city, ousting the Witmos Cabinet, and forcing the resignation of the President.

The Witmos Cabinet had been in existence only since May 5, after the fall of the Ministry of Skrzynski. It was reactionary in character and had suppressed certain newspapers in which its politics had been criticised by Pilsudski. Although this action was given as a motive for the overthrow, it is probable that the real causes lay deeper, in Marshal Pilsudski's fear that the new government would interfere with his hold on the Polish Military forces.

Following the coup, there was much talk of a king-ship or dictatorship for Pilsudski, but the Marshal decided that his aims could be accomplished by quasi-legal methods. A temporary cabinet was organized with Charles Bartel as Premier and Marshal Pilsudski as Minister of War. The Polish National Assembly was convened at the end of May and elected the Marshal as President over the candidate of the parties of the "Right." Pilsudski, however, refused to accept the office.

JUGOSLAVIA'S ADRIATIC COAST.—According to press reports, the completion of the Libra railway has given Jugoslavia her own port on the Adriatic, together with a littoral of 400 miles. Two million tons of merchandise crossed the wharves of Spalato last year, which was six times the commerce of Fiume. The fall of the Pasic cabinet in Jugoslavia is said to have been due to its policy of sacrificing the Adriatic coast in favor of ambitions toward Saloniki.

PORTUGAL

GOVERNMENT OVERTHROWN.—In Portugal during the last few days of May a bloodless revolutionary movement led by army and naval officers brought about the overthrow of the ministry and the establishment of a dictatorship under Commander Cabecadas, a popular naval officer. It was planned to dissolve the parliament and revoke certain laws considered damaging to national interests. In the past four years there have been eleven attempts to overthrow the Portuguese government by force.

RESULTS OF HUNGARIAN COUNTERFEITING TRIALS.—As an outcome of the counterfeiting trials at Budapest, Prince Windisch-Graetz and Chief of Police von Nadossy were found guilty and sentenced to four years' imprisonment. In the trials it was shown that Count Bethlen, the Prime Minister, was aware of the forgery plot early in November. His defense was that he had called for an investigation by Nadossy and others, but that no report had been made up to the time of the exposure.

FAR EAST

FENG ARMIES MENACE PEKING.—On May 30 Peking dispatches announced that the National Army north of Peking had taken the offensive and after two days' fighting had established a line eleven miles from Peking. Marshal Wu Pei-fu's forces were not engaged in meeting this attack.

At Peking, during May, W. W. Yen attempted to establish a new government, with Wellington Koo as one of his chief advisers. There appeared no prospect, however, that a government of any strength or stability would be established, until the three over-lords, Wu, Chang, and Feng, had either come to terms or definitely settled their struggle for supremacy. Wu was reported to have left Hankow for Peking on May 26.

At the close of May Wu's forces began hostilities along the Kwantung border against the rule of the so-called Nationalist party in Canton. In

view of the internal conflicts between communist and moderate factions of this party since the death of Sun Yat Sen, it was believed that little resistance could be offered.

RAW MATERIALS AND WAR.—(From a review of *Dollar Diplomacy*, by Scott Nearing, and Joseph Freeman, written by Prof. R. G. Tugwell of Columbia University, in *Saturday Review of Literature*, May 1, 1926.)

Messrs. Nearing and Freeman are Socialists, and they probably feel that imperialism is merely one other unfortunate aspect of capitalism. In this, I think, even a capitalistic apologist would have to agree with them. Under our present system it is difficult to see how the necessary rubber, hemp, sugar, vegetable oils, coffee, spices, and tropical fruits can be got without that investment of capital abroad which is the essential element in economic penetration and which may so easily lead to political domination. Where I have always felt the anti-imperialists have erred has been in their refusal to state alternatives. Either we have got to do this kind of thing or go without these indispensable raw materials. Somehow, they vaguely hope, most of them, that it can be done otherwise. Messrs. Nearing and Freeman, however, having no sentimental attachment to capitalism, are not afraid of the alternative. They think we ought not to get reluctant oil from Mexico or sugar from the Philippines. Even if it ruined our economic arrangements here at home, that would not seem to them an irreparable loss.

As a matter of fact we may as well face the situation, all of us, that we shall continue to get oil from Mexico on fairly easy terms. And the same is true of other products from other weaker states. We will not let anyone weaker than we are hold us up because we shrink from the possible consequence—the use of force. Perhaps as an economist I state this matter more baldly than most readers will like to see it stated. As a matter of fact I believe Mr. Root put the matter honestly and truly. We may not like it because of moral scruples; we may not think a single American life worth all the bananas in Central America. But if it requires some such sacrifice to keep up the flow of bananas—cheap—we stand ready now, as a nation, I am convinced, to make the sacrifice. We should not make it, if, when the time came, it were clear that the shooting was all about, perhaps; but it will not be. There will be honor involved then and bananas and profits on bananas will be conspicuously absent from public mention. Nor is it clear to an economist what can be done about it. Inevitable is a weighty word, but how else shall we name it? Unless we do what Messrs. Nearing and Freeman would like to have us do—give up the whole mess and start over—what other way out is there? And even then! Perhaps, some anti-imperialist will tell us how we are to get oils, and sugars, and fruits from reluctant señors—or are socialists not fond of coffee, sweets and riding in automobiles?

BOOK REVIEWS

BOOK DEPARTMENT

The Institute Book Department will supply any obtainable naval, professional, or scientific book at retail price, postage prepaid. The trouble saved the purchaser through having one source of supply of all books should be considered. The cost will not be greater and sometimes less than when obtained direct from dealers.

Address all communications to: Secretary-Treasurer, U. S. Naval Institute, Annapolis, Md.

THE METALLURGY OF ALUMINUM AND ALUMINUM ALLOYS. By Robert J. Anderson, Met.E., Sc.D. New York: Baird and Co. $10 net.

Reviewed by D. J. McAdam, Jr., Metallurgist, U. S. Naval Engineering Experiment Station

This is the most extensive book on the subject that has yet appeared. It has 913 pages and 295 illustrations. The references to literature are unusually complete. The list of authors contains more than 500 names. This bibliography consists of references to books and general literature in Chapter I, and a selected bibliography at the end of each chapter.

The subjects of the nineteen chapters are as follows: Chapter I gives a historical survey, a discussion of geographical distribution and general references. Chapters II and III discuss the mining and production of aluminum. Chapters IV and V, physico-chemical properties and corrosion. Chapter VI, general description of aluminum alloys with some photomicrographs. Chapter VII, uses and application of aluminum and its alloys, is very extensive and has numerous illustrations. Chapter VIII, preparation of aluminum alloys, gives details of methods of introducing alloying constituents. Chapter IX on melting practice discusses furnaces and melting methods. Chapter X, secondary aluminum, discusses utilization of scrap. Chapter XI, foundry practice, detailed discussion of methods of difficulties and means of overcoming them. Chapter XII, casting losses and deflects of castings. Chapter XIII, production of die castings, compares die casting and permanent mold casting and gives many illustrations of methods and possibilities. Chapter XIV, rolling and other mechanical treatment. Chapter XV, diagrams of thermal equilibrium, discusses the constitution of alloys by means of diagrams and photomicrographs. Chapter XVI, micrography and macrography, continues the discussion of constitution of alloys. Chapter XVII, heat-treatment of aluminum and its alloys, discusses annealing of cold-worked alloys, and heat-treatment of alloys

such as duralumin. Chapter XVIII, soldering and welding. Chapter XIX, drawing and other methods of fabrication.

In general, the author's discussion of the casting alloys of aluminum is better than his discussion of the wrought alloys and their heat-treatment. His definition of duralumin as "any light aluminum alloy that is susceptible to heat-treatment" is not in accordance with accepted usage. He frequently refers to "duralumins," "zinc duralumins," "special duralumins," etc., whereas the term "duraluminum" should be restricted to an alloy of fairly definite composition. The discussion of alloys for use at elevated temperatures is decidedly incomplete.

While the book is very comprehensive it reminds one of the comment of an ancient writer when at the end of a long letter he apologized, saying; "If I had had more time I could have written you a shorter letter." Many pages are taken up with descriptions and discussion of various methods with the result that no clear impression is left with the reader. Even in the discussion of a single subject, moreover, there is frequently endless repetition of the same idea, sometimes as many as seven times in two successive pages.

The arrangement of the material in the book is also subject to criticism. For example, in Chapter VI there is a general discussion of aluminum alloys with photomicrographs, whereas the chapters on equilibrium diagrams are deferred until near the end of the book. It seems to the writer that the metallography of aluminum would better have been introduced in or immediately following Chapter VI, so that the reader would have its principles in mind through the long subsequent discussion of aluminum alloys.

In spite of these defects the book is of great value as a reference book on aluminum.

ELEMENTS OF RADIO COMMUNICATION. By Ellery W. Stone, Lieutenant-Commander, U. S. N. R., Fellow, Royal Society of Arts; Fellow, Institute of Radio Engineers; Member, U. S. Naval Institute. New York City, 1926: D. Van Nostrand Co. $2.50.

Reviewed by Associate Professor G. D. Robinson, Electrical Engineering and Physics, U. S. Naval Academy

This, the third edition of what was originally published in 1919 as *Elements of Radiotelegraphy*, has been revised and considerably enlarged. Being written primarily for radio students in the Communication Service of the Navy, it has been found desirable to make its presentation substantially non-mathematical. The original text was, in the main, a résumé of a series of lectures intended for students with little or no technical training. Consequently, the first two chapters are devoted to an explanation of the portion of simple electrical theory needed for an understanding of the following chapters of the book.

An unusual feature of the original edition which is retained in the present edition is the treatment of the development of radio equipment from the Marconi 1896 transmitter down to modern forms of transmitting and receiving equipment. Included in this résumé is an unusually thorough treatment of the damped wave transmitter and the "arc" transmitter.

One feature which is thought to be unique is the detailed explanation of the "Nodal Point Signalling System" as applied to the arc transmitter. (This is the type of equipment now used at the high power station, NSS, near Annapolis.) So far as is known, this has not appeared in any other text.

The portion of the text which deals with the three element vacuum tube and circuits for its use has been greatly enlarged since the second edition. It is much better than the preceding edition. The treatment of the three element tube and allied subjects now occupies nearly one fifth of the 433 pages of the book.

Among miscellaneous points of interest might be mentioned: numerous clear photographs, relative freedom from errors, an extensive index, a brief for the use of arcs instead of vacuum tubes, and a list of pertinent papers published by the Bureau of Standards, The Institute of Radio Engineers, and others.

SECRETARY'S NOTES

Important Please Read

An extended study and an analysis of the circulation of the PROCEEDINGS shows that its circulation has about reached a maximum so long as conditions remain as at present. By this is meant that the regular and associate membership of the Naval Institute seems to be as large as can normally be expected in view of the following:

a) the percentages of officers in the various grades who are members of the Institute have been published from time to time in the PROCEEDINGS. These percentages indicate that, for the active list of the line, nine out of every ten Rear Admirals are members; and for the other grades, the circulation shows that the Captains number 70%, Commanders 60%, Lieutenant Commanders and Lieutenants 50%. In other words, it seems that the greater percentage of young officers do not become members until reaching the grade of lieutenant;

b) the Naval Institute has recently gained nearly 300 Associate Members from civilian life, who were obtained by circularizing the membership of the Navy League.

It is evident therefore that for the Naval Institute to increase the circulation of its PROCEEDINGS, it will be necessary to make the PROCEEDINGS more attractive to those in civil life who are eligible for associate membership, or to those who think it sufficiently interesting to be worth the subscription price.

The question naturally follows: "In what way may the PROCEEDINGS be made more attractive to potential civilian Associate Members and at the same time carry out the mission of the Naval Institute?" Is it possible to still retain the high professional standard of the articles and at the same time make the PROCEEDINGS so attractive as to greatly increase the associate membership from the field referred to above?

The Secretary-Treasurer has heard the query answered both in the negative and in the affirmative. Those on the negative side say that it would be impossible, as well as undesirable, to make any radical changes in the PROCEEDINGS without sacrificing to a more or less extent the mission of the Institute, and that it would be un-

desirable to have a large civilian associate membership. Those who answer in the affirmative say that it would be highly desirable to greatly increase the civilian associate membership, and that this might be done by making the PROCEEDINGS more attractive; that by so doing it will appeal to all those in civil life who might have a natural inclination toward the sea and who are sympathetic toward the Navy; that changes could be made which will not lower the high standard of the professional and technical articles. Among the suggested changes are the following:

(1) Change the name of the PROCEEDINGS to "U. S. Naval Institute Magazine." This could not, of course, be done without putting the matter to a vote of the entire regular membership in accordance with the Constitution and By-Laws. The reason given for changing the name is that the word "Proceedings" is a misnomer and has been for many years, although it was the correct word when the Naval Institute was founded. It will be recalled that at the time of its foundation the members of the Institute met from time to time to discuss professional naval subjects and to read professional papers. The practice of publishing the transactions of the meetings together with the publication of the professional papers which were read led to the name "Proceedings," certainly the correct word under the circumstances. The question arises as to whether the new title suggested is a more fitting one as well as one that would make a stronger appeal to the civilian mind. There would be but little loss of identity in such a change, as the words "The United States Naval Institute" would still be retained.

(2) The addition of pictures and illustrations of unusual interest in the PROCEEDINGS has been suggested as one way to create more interest and the Board of Control has already approved of this change, which will be undertaken on a small scale at first with little additional expense.

(3) A third suggestion has been to use the same size type for the "Discussions," "Professional Notes," "Notes on International Affairs," and "Book Reviews," as is used in the main body of the PROCEEDINGS. The reasons are obvious as the smaller type used for these departments is very much harder to read. This would naturally cost more money, but the increased income of the PROCEEDINGS at the present time might very well be put into the magazine for the benefit of the readers. The Board of Control has authorized the editor to take steps to gradually accomplish this result.

(4) A fourth suggestion has been made to increase the page size of the PROCEEDINGS to 7"x10", which is the size of the average magazine published today. Without increasing the amount of material, the publishing cost of binding and press work would be reduced by approximately one-third, the practical results of which would be to reduce by about 40% the increased cost should the entire magazine be printed in the larger type referred to above. The increase in the size of the magazine would not only help to offset the increase in cost due to the use of the larger type, but would also naturally aid in publishing larger and better pictures and illustrations.

(5) A fifth suggestion has been made that there is no necessity for two contents pages, and that the one on the inside should be retained, thus leaving the front cover available for a three-quarter page half-tone engraving of an appropriate illustration. Comment has also been made that the Naval Academy seal has no special significance on the PROCEEDINGS of the Naval Institute, inasmuch as the two organizations have no official connection, and that the Institute's seal on the title page is sufficient.

Of the five suggestions listed above it is apparent that the suggested change of the name "Proceedings" to "Magazine" and the use of the half-tone engraving on the front cover are the only real radical changs, and the Board of Control would not make the former change without reference to a vote of the entire membership, nor would it care to make the latter without comment from the members. The other three suggestions are now being investigated by the Board of Control.

In the meantime the Secretary-Treasurer earnestly requests comments on the five changes suggested, and particularly upon the change of name and the use of the outside front cover for a three-quarter page half-tone engraving.

Circulation The circulation of the PROCEEDINGS since January, 1916, has increased 527 copies; the membership of the Institute, since January, has increased 280 members.

Photos Many opportunities should present themselves to the readers of the PROCEEDINGS to get interesting pictures, and it has been decided to add a picture department to the PROCEEDINGS by beginning on a small scale. Many interesting pictures are taken by the regular commercial companies, and there

appears to be no reason why just as many interesting ones should not be taken by our members for publication in the PROCEEDINGS.

The Institute would therefore be pleased to receive photos of special interest, and, if found acceptable, payment will be made for same, in addition to the usual courtesy acknowledgment when and if published.

Naval Historical Foundation

It has been brought to the Secretary's attention that perhaps some readers of the PROCEEDINGS would be interested to know that it is now possible for them to contribute to the Naval Historical Foundation by leaving a part of their estate to that organization. As the Foundation has been incorporated, it is now possible for a will to provide that a part of one's estate be left to the Naval Historical Foundation. The address of the above organization for the present is Room 2728, Navy Department, Washington, D. C. See articles of Incorporation and By-Laws, published in the May, 1926, issue.

Resignation of Editorial Staff

Due to detachment from the Naval Academy, Lieut. Commander Richard Stockton Field, U. S. N., Assistant Editor of the PROCEEDINGS, and Lieut. Commander H. W. Underwood, U. S. N., compiler of the Professional Notes, have submitted their resignations. The vacancies have been filled by the appointment of Lieut. Commander C. H. McMorris, U. S. N., as Assistant Editor, and Lieut. Commander W. G. Greenman, U. S. N., as the compiler of the Professional Notes.

Commander McCandless Resigns from Board of Control

In view of his orders to sea, Commander Byron McCandless, U.S.N., has resigned as a member of the Board of Control of the Institute, and Commander G. V. Stewart, U. S. N., has been selected to fill the vacancy.

Membership: New members not previously published:

Atherton, C. H. Mr.
Bane, J. C. Mr.
Bertholf, Wallace, Capt. U.S.N.
Bruton, Henry C. Ensign, U.S.N.
Coit, E. S., Miss
DeLeon, C., Mr.
Drury, M. J. Ensign U.S.N.
Fowle, J. R. Mr.
Gates, M. W., Mr.
Chambers, F. T., Captain (CEC), U.S.N.
Gminder, E. E. Ensign, U. S. N.
Gosnell, H. A. Lieut, U.S.N.R.
Hilbert, W. E., Lieut. U.S.N.
Hopping, H. L., Ensign, U.S.N.
Hower, H. H. Mr.
Josephthal, L. M. Rear Adm. N.Y.N.M.
Lahn, J. A., Ensign, U.S.N.
Lee, Chas, S. Mr.
Patterson, T. H. H., Mr.
Pollock, E. T., Capt. U.S.N.
Quigley, W. M., Lt. Comdr. U.S.N.
Robinson, G. B. Mr.
Russell, E. L. Mrs.
Sada, Boulouse, Mr.
Torrance, N. F. Mr.
Upshaw, F. B. Lieut. U.S.N.R.

INSTRUCTIONS FOR CONTRIBUTORS AND MEMBERS

Articles The Institute desires articles of interest to all branches of the service, including the reserve force. Non-members as well as members may submit articles, and authors receive due compensation for articles published. **Compact, well digested articles are more likely to be accepted for early publication.** In accepting articles for publication, the Institute reserves the right to have such articles revised or rearranged, where necessary, in order to bring them up to the required standard of articles published in the PROCEEDINGS—the cost, if any, to be deducted from the compensation due the author.

Contributors are requested to observe the following special instructions in preparing articles for the PROCEEDINGS:

(a) In writing names of ships put only the initial letters in capitals and underscore the names. The underscoring signifies to the printer that the word is to be in italics. The same applies to names of publications. Foreign words not anglicized should also be italicized.

(b) In preparing tables and computations employing fractions, subnumbers, etc., do by hand that part which cannot be made perfectly clear by the typewriter.

(c) In typing the script use double space between lines.

(d) When a quotation is included in an article the editor should be assured by appropriate notation that the writer has carefully verified the quotation as presented.

Reprints Authors of published articles are entitled to twenty gratis copies of reprints.

Discussions Discussion of articles published in the PROCEEDINGS is cordially invited. Discussions accepted for publication are paid for at approximately one-half the rate for original articles.

Book Reviews As soon as practicable after the publication of books on subjects of professional interest, the Institute aims to publish authoritative reviews of them, reviewers being remunerated.

Address of Members In the past, many errors have resulted from the habit of changing an officer's address as soon as his transfer orders are published in the papers. No change will be made in the future except upon receipt of notification by the member concerned. Reliance upon the former method may, in extreme cases, mean a delay of almost four months. To insure the prompt delivery of the PROCEEDINGS and other communications from the U. S. Naval Institute, it is essential that members and subscribers *notify the Secretary-Treasurer without delay of every change of address.* No responsibility can be accepted for failure to receive the PROCEEDINGS, where members fail to comply with this rule. Changes of address should reach the Institute by the 23rd of the month, to be effective for the issue of the PROCEEDINGS of the following month.

SPECIAL NOTICE

Naval Institute Prize Essay, 1927

A prize of two hundred dollars with a gold medal, and a life membership in the Institute (unless the author is already a life member, in which case he will receive the commuted value thereof), is offered by the Naval Institute for the best essay submitted on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. The award of the prize to be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay to the Secretary-Treasurer in a sealed envelope marked "Prize Essay Contest." The name of the writer shall not appear on the essay, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary-Treasurer, with the motto on the outside and the writer's name and motto inside. This envelope will not be opened until after the decision of the board. Essays must be received on or before January 1, 1927.

3. In addition to the "Naval Institute Prize," one or more essays may receive "Honorable Mention," if of sufficient merit to justify that award; or, in the event that no essay is adjudged of sufficient merit to receive the "Prize," the best essay submitted may receive "Honorable Mention" in lieu thereof.

4. In case one or more essays receive "Honorable Mention" the writers thereof will each receive a prize, the amount of such awards to be decided by the Board of Control in each case.

5. Announcement of awards will be made as soon as practicable after January 1, 1927.

6. Essays awarded the "Naval Institute Prize" or "Honorable Mention" will be published in the Naval Institute Proceedings as soon as practicable. Essays not awarded a prize may be published at the discretion of the Board of Control, and the writers of such articles shall be compensated at the established rate for articles not submitted in competition.

7. Articles shall be limited to twenty (20) printed pages in the Proceedings (approximately 8,000 words), but shorter articles will receive equal consideration.

8. In the event of the prize being awarded to the winner of a previous year, a gold clasp suitably engraved will be given in lieu of the medal.

9. All essays must be typewritten, and submitted in duplicate.

H. A. BALDRIDGE,
Captain, U.S.N., Secretary-Treasurer

SUGGESTED TOPICS FOR ARTICLES

Effect of Gas Warfare on the Designs of Ships.
Aviation—Its Present Status and Probable Influence on Strategy and Tactics.
The Anti-Aircraft Problem from the Navy's Viewpoint.
Co-ordination of the Naval Air Force with Other Naval Forces.
Naval Bases, Their Number, Location, and Equipment.
Military Character.
The Relation of Naval Communication to Naval Strategy.
Proportion of National Budget Which Should be Devoted to Naval Expenditures.
The Necessity for Having a Fleet.
Organization of Fleet for War.
The Offensive and Defensive in Gas Warfare.
The Best Protection from Gas Attack.
Naval Gunnery of Today, the Problems of Long Range and Indirect Fire.
Physical Factors in Efficiency.
The Relation between the Navy and the Merchant Marine.
America as a Maritime Nation.
Relation of the Medical Department to a Plans Division.
The Place of Mines in Future Naval Warfare.
A Mobilization Program for the Future.
Morale Building.
The Mission of the Naval Academy in the Molding of Character.
How to Best Educate and Convert the American People to the Need of a Strong National Defense.
The Navy in Battle; Operations of Air, Surface, and Underwater Craft.
Navy Spirit—Its Value to the Service and to the Country.
Based on a Major Ship Strength of Eighteen Dreadnaughts, What Do You Consider a Balanced Navy?
The Future of the Naval Officers' Profession.
The Naval Officer as a Diplomat.
Is the Present System of Training and Education for Officers Satisfactory and Sufficient?
The Rôle of the Navy at Peace.
Training Naval Personnel During the Next Ten Years.
Six Years of Promotion by Selection in U. S. Navy. Its Effect Upon Discipline and Morale.
The Employment of Retired Officers Separated from the Service by Reason of the Age in Grade Feature of the Existing Selection Law.
What Measures Should be Adopted to Create and Maintain a Balanced Enlisted Personnel of 120,000 Men?
Our Future Naval Policy Based on Existing International Treaties.
The Future Naval Continental Shore Establishments.
Shore Duty for Enlisted Men.
The Limits of Specialization in Naval Training.
The Effect of the 5-5-3 Ratio Upon U. S. Naval Strategy in the Eastern Pacific.
Armor or High Speed for Large Surface Vessels?
Airplanes and Submarines Versus Super-Dreadnaughts.
The Navy's Relation to the Nation in World Affairs.

THE DARDANELLES EXPEDITION

By Captain W. D. Puleston, U. S. Navy

A critical study of this amphibious undertaking designed primarily for Army and Navy officers. It is based on official accounts of the British Admiralty, the Turkish General Staff, the Australian Army, the British Parliamentary Report, and the semi-official accounts by General Hamilton, General von Sanders, Admiral Weymss, and Winston Churchill.

The book is illustrated by sixty-eight diagrams, which alone will give a connected pictorial story of the expedition from its inception to evacuation. The text is mainly used to furnish the political background at the various European capitals and to connect up the naval, military, and political events, which so profoundly affected this expedition.

The illustrations were prepared by Lieutenant Colonel G. L. McEntee, General Staff, U. S. Army, from data collected for four years by Captain Puleston. Other Army officers at the Army War College, notably Lieutenant Colonel W. B. Burtt, General Staff, U. S. Army, assisted the author in preparing that part of the text affecting the Army.

Special efforts have been made to insure accuracy in all facts stated in this book and to give in one volume a complete story of this campaign.

Lectures based on this study have been given by Lieutenant Colonel McEntee at the Naval War College and throughout the First Corps Area, and joint lectures by Colonel McEntee and Captain Puleston have been given at the Army War College, the Marine Corps Schools at Quantico, and the Naval Post Graduate School at the Naval Academy. Slides made from these illustrations are being used in lectures at the Coast Artillery School, Fortress Monroe.

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